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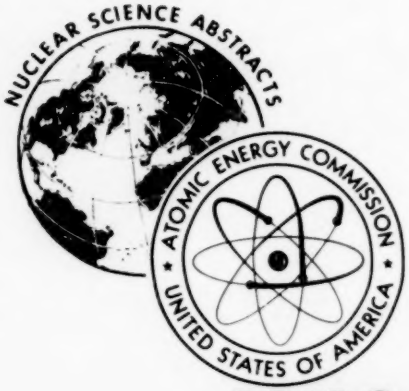

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Volume 17 Number 24

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Volume 17, Number 24, December 31, 1963

NUCLEAR SCIENCE ABSTRACTS

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Volume 17, Number 24 December 31, 1963

NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

40421 (ANL-6766) CHEMICAL ENGINEERING DIVISION RESEARCH HIGHLIGHTS, MAY 1962–APRIL 1963. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 155p.

Research and development are reported in the following areas: development of processes and equipment for the recovery of fissionable and fertile materials from spent reactor fuels; development of methods for the synthesis and production of reactor fuels and materials; studies of methods for the direct conversion of heat to electricity; basic engineering studies of unit operations, heat transfer, and mass transfer in nonaqueous systems; basic studies of the chemistry of substances of interest to nuclear technology; studies of chemical reactions important to the safe handling of nuclear fuels and safe operation of reactors; determination of nuclear constants, such as fast neutron cross sections of importance to the design and performance of fast breeder reactors; and analytical chemistry in support of the research and development programs. (auth)

40422 (ANL-6784) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, SEPTEMBER 1963. (Argonne National Lab., Ill.). Oct. 15, 1963. Contract W-31-109-eng-38. 80p.

Progress is reported for BORAX-V, liquid-metal-cooled reactors, nuclear physics, fuels development, chemical separations, plutonium recycle program, Advanced Research Reactor, magnetohydrodynamics, nuclear safety, and TREAT. (D.L.C.)

40423 (BMI-1639(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JUNE 1963. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). July 1, 1963. Contract W-7405-eng-92. 73p.

Progress is reported for the following areas: reactor materials and components, fuel element development, radiation applications, tracer system for in-place filter evaluation, development of coated-particle fuels, corrosion studies for fluoride-volatility process, creep-rupture properties of SAP alloys, mechanical properties of Zr alloys, fission-product deposition, irradiation studies, and properties of UO_2–ZrO_2 bodies. (D.L.C.)

40424 (BMI-1642(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JULY 1963. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Aug. 1, 1963. Contract W-7405-eng-92. 71p.

Progress is reported for the following programs: reactor materials and components, studies of fuels, fuel element development, radioisotope and radiation applications, tracer system development for in-place filter evaluation, coated-particle fuel materials, corrosion studies of fluoride volatility process, creep-rupture of SAP alloys, mechanical properties of zirconium alloys, fission-product deposition studies, irradiation studies, gas-cooled reactor program, and joining of regenerative cell components. (D.L.C.)

40425 (NP-13164) AUSTRALIAN ATOMIC ENERGY COMMISSION ELEVENTH ANNUAL REPORT, 1962–1963. (Australia. Atomic Energy Commission). June 30, 1963. 76p.

Activities of the Australian Atomic Energy Commission are reviewed for the year ending June 30, 1963. Investigations were made of the feasibility of a high-temperature, gas-cooled thermal reactor for power production. Aerial and ground surveys were conducted in a search for U minerals. Ore treatment research was carried out in 3 operating U ore treatment plants. Data are included on U mining and production. The problem of future supplies of U for nuclear power was surveyed. Data are summarized from studies of radiation effects on beryllia and fuel samples irradiated in HIFAR. A process was developed for the recovery of fissile material plus Be from spent fuel elements operating on a U/Th fuel cycle. Operation of the HIFAR, reactor research, support and associated research, and isotope production, supply, and applications are discussed. Research and training programs of the Australian Institute of Nuclear Science and Engineering are summarized. (C.H.)

40426 (NYO-10063) PROGRESS REPORT [ON NUCLEAR SCIENCE]. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). May 1, 1963. Contract AT(30-1)-2098. 134p.

Progress in nuclear science is reported under the following topics: chemistry of fission elements, nuclear chemistry (organic), nuclear chemistry (inorganic), cosmic radiation, bubble chamber, linear accelerator, high-energy accelerator physics, ONR generator, radioactivity, cyclotron, and theoretical. Separate abstracts were prepared for each topic. (M.C.G.)

40427 (NYO-10063(p.1-6)) CHEMISTRY OF THE FISSION ELEMENT GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Ultraviolet spectrophotometric studies of the reaction between bismuth(III) and iodide ions in a sodium perchlorate, perchloric acid medium of constant ionic strength

were carried out over a considerable range of bismuth and iodide concentrations. The radiofrequency plasma photometer is operative and a survey is being made of its accuracy, sensitivity, and reproducibility. Preliminary detection limits with a plasma torch source were determined for Al, Ca, Cd, Li, Mg, Pt, Sn, and Zn. Measurements with sodium amalgam electrodes provided the values for transference numbers in sodium perchlorate solutions in the range of 4 to 10 molal. Experimental studies indicated that column separation of alkali metals should be readily achievable in liquid ammonium medium at −74°C. It was found possible to adapt a commercial nuclear magnetic resonance spectrometer for measurement of proton relaxation times. A number of polarographic and potentiometric measurements were made on aqueous solutions of the complexes formed between silver ion and cyclooctatetraene. A time device was constructed that controls the drop time of a dropping mercury electrode and also switches on a constant current at any preselected time during the growth of the mercury drop. Methods are being developed for the preparation of single-crystal electrodes. Electrodes are being prepared for potentiostatic chromatography. Attempts were made to modify the behavior of ion-exchange membranes, as used in concentration cells. The dependence of half-cell potential on concentrations was measured with a solution of sodium naphthalenide in tetrahydrofuran solvent. (M.C.G.)

40428 (NYO-10063(p.7-22)) NUCLEAR CHEMISTRY (ORGANIC) GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

The mechanisms of methanolysis and radiochloride exchange reactions of triphenylmethyl chloride in benzene were investigated. Nitrogen isotope effects were measured for the free-radical decomposition of benzene-, m-chlorobenzene-nitrobenzene-, and p-nitrobenzene-azotriphenylmethanes with excellent precision. Equilibrium isotope effects were determined for distribution of protium and deuterium between water and several oxonium ions. Further checks were made on the mechanism of the Cannizzaro reaction. Examination of the sterospecificity of the termination reaction of α-phenylethyl radicals was extended to the transient 2-phenylpropionyl peroxide. Studies of the mechanism of decomposition of diacyl peroxides were continued. Calculations of C^{13} hyperfine interactions in electron spin resonance spectroscopy of hydrocarbon radicals were extended to cover aliphatic and alicyclic radicals. (M.C.G.)

40429 (NYO-10063(p.23-51)) NUCLEAR CHEMISTRY (INORGANIC) GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Improvements in research facilities are described. The characteristics of 3 sulfonated polystyrene resins were compared with those of Dowex 50 w resins. Electrolyte behavior in concentrated LiCl and LiBr solutions was studied and a quantitative formulation of species developed. Thermodynamic studies were made of $Pb(ClO_4)_2-HClO_4-H_2O$ electrolyte solutions by the isopiestic method. Properties of amines for solvent extraction are being investigated. A gas sampling device that allows determination of gaseous halogen components in the atmosphere was developed. The analytical method for determining variations in the ratio $Ca^{48}/Ca_{(total)}$ in the natural environment is fully operative. A study of the 55-sec bromine activity formed in fission resulted in the identification of radiations emitted by 54-sec Br^{88} and 55-sec Br^{87}. Decay schemes for each are proposed. Half lives were determined for Sb^{134} and Sb^{135}. Studies were made of Cd^{117} isomers and what was previously believed to be a 50-min isomer of Cd^{117} is attributed to Cd^{118}. Cross sections are given for the reaction of B^{11} and C^{12} ions with Cd^{116}. Differential ranges of near-symmetric fission products of U^{235} were studied. Calculations were made of the efficiencies of various types of bent-crystal x-ray spectrometers. Chemical shifts in x-ray spectra are being investigated. (M.C.G.)

40430 (NYO-10063(p.52-60)) COSMIC RAY GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Gamma-ray data from Explorer XI were studied. A model is being developed to explain cosmic-ray origin and radio noise. Theoretical investigations of the behavior of galactic cosmic rays as a relativistic gas were initiated. Measurements made on interplanetary plasma by Explorer X were analyzed. Tests were made of plasma probes. Theoretical studies were made on the interaction of the solar wind with the earth's magnetic field in the sub-solar region. A detector was developed to evaluate the background neutral cosmic ray flux. The air shower experiment at Mt. Chacataya, Bolivia was continued with routine accumulation of data. The air shower experiment at the Volcano Ranch station at Albuquerque detected a shower caused by a primary cosmic ray of energy close to 10^{20} ev. Properties of Cherenkov light associated with cosmic showers are being studied. (M.C.G.)

40431 (NYO-10063(p.61-2)) BUBBLE CHAMBER GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

The complete spark chamber system and counters were assembled and tested with cosmic rays. The 12-in. hydrogen chamber was assembled and tested on liquid nitrogen. The 40-in. hydrogen chamber was completely assembled and tested at room temperature. The 240-ton magnet for the 40-in. chamber was assembled and tested. A prototype of the digital servo to be used in PERR (Precision Encoding and Patter Recognition) was completed and demonstrated to have the necessary precision. (M.C.G.)

40432 (NYO-10063(p.63-70)) LINEAR ACCELERATOR GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Studies were made of the $Pb^{208}(\gamma,n)$ reaction and time-of-flight spectra were obtained. An investigation of the photodisintegration of the deuteron at low energy ($h\nu \leq 20$ Mev) is in progress. (M.C.G.)

40433 (NYO-10063(p.71-89)) HIGH ENERGY ACCELERATOR PHYSICS GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Apparatus for the π^0-photoproduction experiment, hodoscopes, magnet platform, magnets and associated electronics, were placed in operation. Cross sections for the $\gamma + p \rightarrow \pi^0 + p$ reaction were plotted for 0 to 2.3 Mev. Events in the interactions of photons with deuterium are being analyzed. Apparatus for studying the Λ^0 gyromagnetic ratio was assembled. Data on $\pi - p$ and $\bar{K} - p$ elactic scattering are presented in graph form. Evidence for the formation of quasi-deuterons in the nitrogen nucleus was sought in π^+ reactions with nitrogen. A search is being made for ζ^+ in $\pi^+ + p$ reactions. A momentum-analyzing spark chamber with scintillation-counter triggers was designed. The elastic scattering cross sections for gamma rays by protons in the energy range from 550 to 850 Mev were measured. An experiment to measure the cross section for the photoproduction of μ pairs from

carbon is being carried out. Proton-proton and meson(π)-proton scattering studies were also carried out. The cross section for photoproduction of intermediate boson pairs in the reactions $\gamma + p \rightarrow p + W^+ + W^-$ and $\gamma + p \rightarrow Z + W^+ + W^-$ was calculated. (M.C.G.)

40434 (NYO-10063(p.90-8)) ONR GENERATOR GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

The studies of nuclear energy levels through charged-particle reactions were continued. The work was concentrated mostly in the area of (d,p) reactions on B^{10}, N^{15}, Ca^{40}, Ca^{42}, Ca^{44}, Cr^{52}, Ce^{140}, Pr^{141}, and Lu^{175}. He^3 reactions with Ca^{40} and Ar^{40} were also studied. Apparatus improvement and development is discussed. (M.C.G.)

40435 (NYO-10063(p.99-104)) RADIOACTIVITY GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

A program was begun to study the angular precession of α-γ correlations. Measurements were made of the magnetic moment of the first-excited state of Te^{125} in Mössbauer scattering experiments. Magnetic moments are being determined by Dy^{161} from Mössbauer scattering patterns. Equipment and methods are being developed and tested for measurements of lifetimes of short-lived states fed by alpha decay. Measurements were made of α-γ angular correlations in Bi^{212} decay. (M.C.G.)

40436 (NYO-10063(p.105-15)) CYCLOTRON GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab for Nuclear Science).

The resolution obtainable with a NaI(Tl) scintillation crystal used as the spectrometer for 160-Mev protons was studied. Analyses were made of alpha spectra from alpha-induced reactions on 23 nuclei (Al^{27}, Ca^{40}, Tl^{48}, V^{51}, Fe^{56}, Co^{59}, Ni^{58}, Ni^{60}, Ni^{61}, Ni^{62}, Cu^{63}, Zr^{90}, Nb^{93}, Mo^{96}, Rh^{103}, Pd^{106}, Cd^{113}, Cd^{114}, Sn^{119}, Sn^{120}, Sn^{124}, Ta^{181}, Pt^{195}, and Au^{197}). (M.C.G.)

40437 (NYO-10063(p.116-25)) THEORETICAL GROUP. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

Theoretical studies are being made of excited states in odd-A nuclei using the quasiparticle approach. Higher-random-phase approximation is being used to describe the higher collective states in nuclei. Pairing effects in deformed nuclei are being studied. In studies of the nuclear model Hamiltonian, all S, P, and D phase shifts were fitted to a separable, velocity-dependent two nucleon interaction. Calculations of the binding energy of nuclear matter are progressing. An optical-model picture is being used to describe proton-proton interactions. Conserving approximations in many-body theory are being studied. Calculations are being made of the effects of particle-hole excitations in nuclear scattering. A shell-model calculation was made of the imaginary part of the optical model potential for neutron interactions with heavy nucleus. The elastic and Raman dipole scattering from nuclei with quadrupole collective motions are being calculated. Work is being carried out on the boundary condition model. Necessary conditions for a field theory to accomplish reggization of an elementary particle were found. A method was found for solving field-theory functional equations. (M.C.G.)

40438 THE EFFICIENT IMPORTATION AND DISTRIBUTION OF RADIOISOTOPES. Suggestions for the Most Economic Importation of Radioisotopes. (International Atomic Energy Agency, Vienna). Technical Report Series No. 19. Aug. 1963. 26p. (STI/DOC/10/19). $1.00; Sch 21,-; 6s.stg; F.fr. 4,-; DM 3,20(IAEA).

Import procedures governing radioisotopes are reviewed. It is pointed out that in most countries the importation of radioisotopes is subject to the general laws and regulations regarding control of foreign exchange, import license, and customs clearance, plus special laws and regulations covering special hazards involved. Authorizations that may be necessary for each shipment are outlined. Other topics discussed include the choice of suppliers, means of transportation, size of shipments, the importation of labeled compounds, the production of short-lived radioisotopes, the distribution of isotopes, and the domestic production of labeled compounds. (C.H.)

40439 ANNUAL REPORT TO CONGRESS OF THE ATOMIC ENERGY COMMISSION FOR 1962. (Atomic Energy Commission, Washington, D. C.). Jan. 1963. 619p.

The 1962 atomic energy programs are reviewed under the following headings: Commission actions in support of industry and science, general Commission actions, community support, nuclear power development study, civilian power reactors program, maritime reactors, Project Rover, Project Pluto, SNAP program, army reactors program, naval reactors program, nuclear safety program, raw materials, production, radioactive wastes management, military application, Plowshare program, radioisotope development, international activities, international conferences and exhibits, biology and medicine, physical research, classification and declassification, information programs, exhibits, education and training, contracting policy, industrial relations, and regulatory activities. (M.C.G.)

40440 MAJOR ACTIVITIES IN THE ATOMIC ENERGY PROGRAMS, JANUARY-DECEMBER 1961. (Atomic Energy Commission, Washington, D. C.). Jan. 1962. 550p. $1.75 (GPO)

Major AEC programs for 1961 are discussed under the following topics: industry, space and military reactor activity, civilian nuclear power program, nuclear power for space, progress in power-reactor technology, maritime reactors, military application, raw materials, production, radioisotope development, Plowshare program, nuclear safety program, international activities, biology and medicine, physical research, classification and declassification, information, education and training, contracting policy, industrial relations, operational safety, inspection and appraisal, nuclear materials management, construction, mobilization planning, community activities, organization and personnel, and regulatory activities. (M.C.G.)

BIOLOGY AND MEDICINE

General and Miscellaneous

Refer also to abstract 41074.

40441 (HW-SA-2867) SERUM HEMAGGLUTININS IN HETEROLOGOUS CHIMERAS. E. M. Uyeki (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.) Jan. 10, 1963 Contract AT(45-1)-1350. 6p.

Graft anti-host and host anti-graft antibodies were demonstrated in the sera of mouse heterologous radiation chimeras. Both types of serum hemagglutinins were detected 3 to 4 weeks post-treatment. The specificity of the agglutinins is discussed. (C.H.)

40442 (NP-13175) "THYROIDITIS" IN DOGS. Summary Report. M. A. Ross (Armed Forces Inst. of Pathology, Washington, D. C.). Apr. 1, 1963. 11p.

Thirty-seven of 251 dogs fed various foods processed by radiation showed some evidence of thyroiditis. No connection was found between the condition and the diet. A statistical analysis of data on dogs from various sections of the U.S. indicated a possible effect of geography on incidence of thyroiditis. A comparison of the data with data on human deaths from thyrotoxicosis tended to confirm the geographical etiology of the two conditions. It is suggested that the mineral content of drinking water may be a factor in both conditions. (C.H.)

40443 (NP-13182) MOUSE CARCINOGENICITY STUDY. Final Report, March 1, 1957–May 30, 1963. (Miami, Fla. Univ., Coral Gables. School of Medicine). Contract DA-49-007-MD-789. 12p.

A diet containing irradiated tuna, fruit compote, beef, corn, and sweet potatoes was fed to several strains of mice for the duration of their life. The mice were observed daily and their tissues were examined grossly and studied histopathologically for the occurrence of tumors. The irradiated diet had no effect on weight, food consumption, life span, or tumor incidence of the mice when compared with controls maintained on nonirradiated foods. The tumors found were classified according to type. (C.H.)

40444 (NP-13183) HEMORRHAGIC SYNDROME IN RATS FED IRRADIATED BEEF. Progress Report No. 7, September 1, 1962–March 1, 1963. E. A. Doisy, Jr. and J. T. Matschiner (Saint Louis Univ. School of Medicine). 9p.

Studies on the effects of irradiated beef in the diet on the induction of the hemorrhagic syndrome in rats indicate that the condition may be the result of irradiation destruction of vitamin K in beef. Data are presented on prothrombin levels observed in rats on purified diets and diets containing beef, soy, casein, casein plus squalene, extracted beef proteins, or rendered or extracted beef fat, and in chicks on diets containing various oils. (C.H.)

40445 (TID-18185) SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF LIPOXIDASE ACTIVITY: OBSERVATIONS ON UNSATURATED-FAT OXIDASE. Kenneth Surrey (Argonne National Lab., Ill.). Nov. 1962. Contract W-31-109-eng-38. 25p. (UAC-7118)

An improved spectrophotometric method for the determination of lipoxidase activity was developed and applied in studies of the purified enzyme and crude enzyme preparations from leguminous and other seeds, with linoleic acid as the substrate. The optimum pH was found to be 7.0, 6.5, 6.0, and 5.5 for purified lipoxidase and for the crude lipoxidases from graham flour, soy bean meal, and hydrated mung beans, respectively. Hydrated mung beans showed two distinct modes of oxidation, the initial phase mediated by a nonspecific unsaturated-fat oxidase and the succeeding phase by lipoxidase. Brassica and lettuce seeds did not oxidize linoleic acid probably because of their antioxidant contents. Oxidation by wheat and barley seed extracts indicated that their activity was presumably due to the unsaturated-fat oxidase rather than lipoxidase. On the basis of the resistance of lipoxidase to enzyme inhibitors and ionizing radiation it is postulated that lipoxidase plays no role in the initiation of seed germination. The unsaturated-fat oxidase was found to be radiation sensitive, but its role in germination remains to be established. (auth)

40446 THE CONCEPT OF GENETIC LOAD: A CRITIQUE. L. D. Sanghvi (Univ. of Michigan, Ann Arbor). Am. J. Human Genet., 15: 298-309(Sept. 1963).

Difficulties in accepting a provocative scheme by Crow (Human Biol. 30, 1-13(1958) to evaluate the relative importance of mutational and segregational loci in maintaining our hereditary burden are discussed. The genotype used as standard of comparison in the previously developed mutation model is not the same as the one used in his segregation model. A logical approach will require a fixed standard of comparison for the two models. A scheme is outlined in which the same genotype is used for evaluating the inbreeding effects on the two types of loci. It turns out that the appropriate test criterion for this purpose should be 1—B/1—A and not B/A as previously suggested. Other points related to the concept of genetic load are also discussed. (P.C.H.)

40447 THE CONCEPT OF GENETIC LOAD: A REPLY. James F. Crow (Univ. of Wisconsin, Madison). Am. J. Human Genet., 15: 310-15(Sept. 1963).

A previously proposed concept of genetic load by Crow (Human Biol. 30, 1-13(1958) is clarified and defended. (P.C.H.)

40448 THE WAY THE LOAD RATIO WORKS. C. C. Li (Univ. of Pittsburgh). Am. J. Human Genet., 15: 316-23 (Sept. 1963).

The main features and implications of the genetic load ratio are discussed. This included the method of load ratio and the definition of genetic load. (P.C.H.)

40449 A METHOD FOR RAPID LABELLING OF ERYTHROCYTES WITH ^{51}Cr. H. Kuni, E. H. Graul, H. Hundeshagen, and E. Schaumloeffel (Phillips-Universitat, Marburg, Ger.). Atompraxis, 9: 377-80(Sept. 1963). (In German)

A method for rapid labeling of erythrocytes with Cr^{51}, based on ion exchange, makes it possible to label erythrocytes from a patient in around eight minutes. The development of the procedure, its clinical use, and its advantages and disadvantages are discussed. The method is particularly suited for use in conjunction with blood-volume determination using the semi-automatic measurement and calculating device Volemetron. (auth)

40450 XXII NATIONAL CONGRESS ON MEDICAL RADIOLOGY AND NUCLEAR MEDICINE, CATANIA,

MAY 13-16, 1963. VOLUME I. Atti, Congr. Nazl. Radiol. Med. Med. Nucl., 22°, Catania, 1963, 1: 1-513(1963). (In Italian)

Four papers are included; separate abstracts have been prepared for each. (J.S.R.)

40451 PHYSICAL AND BIOLOGICAL PRINCIPLES OF INTERNAL RADIODOSIMETRY. Paolo Ollino. Atti, Congr. Nazl. Radiol. Med. Med. Nucl., 22°, Catania, 1963, 1: 1-99(1963). (In Italian)

The physical and biological principles of internal radiodosimetry are reviewed to give the theoretical basis necessary to resolve the various problems inherent in internal radiodosimetry. (J.S.R.)

40452 METHODOLOGICAL BASES AND APPLICATIVE ASPECTS. A. Laconi. Atti, Congr. Nazl. Radiol. Med. Med. Nucl., 22°, Catania, 1963, 1: 101-386(1963). (In Italian)

The methodological and technical basis and the applicative aspects of internal dosimetry are reported with emphasis on the biological and metabolic parameters. The principal techniques and methods used on experimental animals and humans: classical procedure of mathematical calculation, film dosimetry, and solid state microdosimetry with radiophotoluminescence are described. The applicative aspects are considered. The distribution, concentration, and dosimetry of radiocolloids are discussed. (J.S.R.)

40453 DOSIMETRIC PROBLEMS IN THE ADMINISTRATION OF RADIOISOTOPES INTERNALLY FOR DIAGNOSTIC PURPOSES. G. L. Buraggi and G. Fava. Atti, Congr. Nazl. Radiol. Med. Med. Nucl., 22°, Catania, 1963, 1: 387-431(1963). (In Italian)

The methods for the calculation of the dose received by the patient during diagnostic tests with internal administration of radioisotopes are reported. The basic parameters for such calculations are analyzed. Particular reference is given to the discussion of the methods for the experimental determination of the values of these parameters. Values of the EBR dose, relative to the various organs, and of the total integral absorbed dose are tabulated. (J.S.R.)

40454 DOSIMETRIC PROBLEMS IN THERAPY WITH RADIOCOLLOIDS. Carlo Bompiani. Atti, Congr. Nazl. Radiol. Med. Med. Nucl., 22°, Catania, 1963, 1: 433-513 (1963). (In Italian)

The effects of various factors that can affect the effective absorbed dose of the tissues in radiotherapy with radiocolloids are studied. Radiocolloids of Au^{198}, P^{32}, and Y^{90} are used. A mathematical evaluation is made of the dose absorbed by the irradiated tissue in endocavity, interstitial, and endovascular injection therapy. The local dose distribution was determined. Both the absorbed dose and dose distribution are greatly affected by geometric factors. Biological factors affecting the absorbed dose and dose distribution are of secondary importance to the physical and geometric factors. (J.S.R.)

40455 XXII NATIONAL CONGRESS ON MEDICAL RADIOLOGY AND NUCLEAR MEDICINE, CATANIA, MAY 13-16, 1963. VOLUME III. Atti, Congr. Nazl. Radiol. Med. Med. Nucl., 22°, Catania, 1963, 3: 1-315(1963). (In Italian)

Three papers are included; separate abstracts have been prepared for two. (J.S.R.)

40456 METHODS, VALUE, LIMITATIONS, AND INDICATIONS OF THE RADIOLOGICAL STUDY OF THE LYMPHATIC SYSTEM BY LYMPHOGRAPHY. Lucio Rossi. Atti, Congr. Nazl. Radiol. Med. Med. Nucl., 22°, Catania, 1963, 3: 1-182(1963). (In Italian)

The methods, limitations, and indications in the radiological study of the lymphatic system are reviewed. The value of the various methods is indicated. The topics discussed are lymphadenographic techniques, radiographic anatomy, physiology of the lymphatic system, physiopathology of the lymphatic system, modifications of the lymph system, lymph nodes, and the thoracic duct. 824 references. (J.S.R.)

40457 THE LYMPHATIC SYSTEM AND IONIZING RADIATIONS. Giacomo Bassani. Atti, Congr. Nazl. Radiol. Med. Med. Nucl., 22°, Catania, 1963, 3: 237-315 (1963). (In Italian)

A bibliographic review is presented of the effects of ionizing radiations on the lymphatic system. The topics discussed are the regeneration of irradiated lymphatic tissue, irradiated lymph nodes, filtration functions in the irradiated lymph nodes, methods for the detailed study of lymph nodes, distribution of radioactivity in the lymphatic system, and radiation effects on the lymph and lymph vessels. 211 references. (J.S.R.)

40458 BIOPHYSICS IN MEDICAL RADIOLOGY. Boris Rajewsky (Max-Planck-Instituts für Biophysik, Frankfurt am Main). Indian J. Radiol., 16: 65-82(May 1962).

The history of the development of the science of radiological physics is reviewed with emphasis on changes in basic concepts of the nature of the physical processes and chemical reactions induced in tissue by radiation. (C.H.)

40459 THOUGHTS ON SELECTION OF RADIOTHERAPY APPARATUS. A. D. Singh (Christian Medical Coll. Hospital, Vellore, India). Indian J. Radiol., 17: 25-31(Feb. 1963).

The selection of radiotherapy equipment is discussed from the standpoint of the needs of India. The cost and need for both orthovoltage and supervoltage equipment is considered. The criteria for high-energy equipment and equipment available are summarized. It is concluded that a 4-Mev linear accelerator is one of the best radiotherapy machines but it is not suited to use in India. Telecobalt and telecesium units are better suited to operating conditions prevailing at present. The advantages, disadvantages, and cost of the various units available are compared. (C.H.)

40460 A METHOD OF SAMPLE PREPARATION FOR THE ESTIMATION OF Fe^{55} IN WHOLE BLOOD BY THE LIQUID SCINTILLATION COUNTING TECHNIQUE. S. W. Perry and G. T. Warner (Nuffield Dept. of Clinical Medicine, Oxford). Intern. J. Appl. Radiation Isotopes, 14: 397-400(Sept. 1963). (In English)

A method is described for the liquid scintillation counting of Fe^{55} and Fe^{59} in whole blood, with an efficiency of 2% for Fe^{55} and 26% for Fe^{59}. Separation of the iron is achieved by wet digestion of the whole blood, and precipitation of the iron as ferric hydroxide, eliminating the need to electroplate. The optimum amounts of hydrochloric and ascorbic acid for the solution and reduction of the precipitated ferric hydroxide were determined together with the optimum counter setting for separation of the two isotopes. (auth)

40461 ALPHA PARTICLE AND PROTON BEAMS IN THERAPY. John H. Lawrence, Cornelius A. Tobias, James L. Born, Alexander Gottschalk, John A. Linfoot, and Robert P. Kling (Univ. of California, Berkeley). J. Am. Med. Assoc., 186: 236-45(Oct. 19, 1963).

A high-energy alpha-particle beam, which has the advantageous properties of great penetration, relative

lack of scatter, and greater biological effect per unit of ionization at the Bragg peak in the depths, was used to deliver enormous amounts of energy to localized areas of the body, including the pituitary gland, brain, and soft tissues. Successful clinical results in the treatment of metabolic, neoplastic, and neurological disease were observed. (P.C.H.)

40462 APPROPRIATED X-RAY PROTECTION OF THE OVARIES IN RECUMBENT POSITION. Károly Gefferth. Magy. Radiol., 15: 221-6(Aug. 1963). (In Hungarian)

A shield covering only the ovaries was constructed. Twelve different sizes are available from the newborn age to the end of the growth. On the basis of exact measurements a decrease of 70% of the radiation in the protected areas is obtained. The mode of the preparation of the protective shield is described briefly. (auth)

40463 RADIUM TREATMENT OF THE PLASTIC INDURATION OF THE PENIS AND THE PROBLEM OF THE RAY-PROTECTION. Gyoergy Kárpáti, Iván Rojtor, and Gyoergy Pátkai. Magy. Radiol., 15: 227-31(Aug. 1963). (In Hungarian)

On the basis of experiences obtained in a large material it was found that radium treatment of the plastic induration of the penis is very useful especially in the form of moulage and application. In the cases suitable to the radium moulage treatment approximately 1500 r doses are administered in a series, and in the case of application, doses of 2000 r are given. From measurements using a special protective shield, complete radiation protection of the testes is obtained. (P.C.H.)

40464 BEHAVIOR OF NONINFECTIOUS SV 40 VIRAL GENOME IN HAMSTER TUMOR CELLS: INDUCTION OF SYNTHESIS OF INFECTIOUS VIRUS. Albert B. Sabin and Meinrad A. Koch (Univ. of Cincinnati). Proc. Natl. Acad. Sci. U. S., 50: 407-17(Sept. 15, 1963).

In transplanted SV 40 hamster tumors spontaneous development of infectious virus occurs only in an occasional cell out of many millions that carry the viral genome in a noninfectious state, more frequently in older tumors than in those that have grown for less than four weeks. No infectious nucleic acid capable of producing complete SV 40 virus in susceptible Cercopithecus cells was found in the tumor cells. Induction of a greater frequency of synthesis of infectious virus in tumor cells has now been demonstrated by three procedures: propagation of the tumor cells in vitro — more frequently in rolled than in stationary cultures, although the latter are more suitable for optimum growth of the tumor cells; by association of viable tumor cells with susceptible cells under certain conditions of contact which do not require either proliferation or persistence of the tumor cells; by an x-ray effect on a very small proportion of the tumor cells. SV 40 tumors transplanted in newborn hamsters yield a satisfactory complement-fixing antigen which reacts specifically only with the sera of hamsters bearing SV 40 tumors but not with sera of hamsters bearing either polyoma tumors or Fortner fibrosarcoma no. 3 tumors. Hamsters bearing transplanted SV 40 tumors for four weeks or longer also develop complement-fixing antibody for an antigen present in BS-C-1 Cercopithecus cells infected with SV 40 virus, although these sera contain no neutralizing antibodies. Adult hamsters inoculated with large doses of SV 40 virus, which induces a specific resistence to transplantation of SV 40 tumor cells, possess no antibody for the antigen in the tumor or the antigen in the SV 40 virus-infected Cercopithecus cells. The available data are not sufficient for a conclusion that the noninfectious viral genome in the SV 40 tumor cells carries information for the synthesis of at least a part of the viral antigen, although it gives rise to antigens that are specific for the SV 40 virus. The data on induction of infectious virus in the SV 40 tumor cells provide a new approach to the search for etiologically significant, dormant viruses in human cancers. (auth)

40465 A METHOD FOR FORCE-FEEDING RADIOISOTOPES TO YEARLING TROUT. R. E. Nakatani (General Electric Co., Richland, Wash.). Progressive Fish Culturist, 24: No. 2, 56-9(Apr. 1962). (HW-SA-2303)

A practical force-feeding method that was employed to study the effects of chronic feeding of $Sr^{90}-Y^{90}$ to yearling trout is described. The basic procedures in the method are to prepare gelatin capsules with measured amounts of isotope solution and to eject the capsule with the aid of a special ramrod into the stomach of an anesthetized fish. Afterwards each fish should be held for observation for a few minutes to check for possible regurgitation of the capsule after force-feeding. (P.C.H.)

40466 DOSIMETRIC STUDY RELATIVE TO HYPOPHYSIAL IMPLANTATION OF Y^{90} USING CYLINDRICAL PREPARATIONS. G. Juliani (Università, Turin). Radiol. Med., 49: 650-68(Aug. 1963). (In Italian)

In interstitial hypophysial beta-therapy using Y^{90}, estimation of the dose based only on the over-all activity of the preparations may lead to markedly erroneous deductions. It is, instead, desirable to be able to determine the volume of the portion of hypophysis reached by doses sufficient to cause complete destruction. A method allowing this estimation in cases where cylindrical sources of Y^{90} are used is described. The determinations can be considered sufficiently correct if a single preparation only is implanted, or if two or more sources are arranged on the same plane. In the more frequent occurrence of the use of two or more sources implanted at different planes, calculation of the dose becomes more complicated and, at the same time, imprecise. It is suggested that spherical sources, in small number and of rather high activity, are most suitable. This technique should guarantee not only greater uniformity in the distribution of the dose, but also a more accurate estimation of the dose. (auth)

40467 WHOLE ABDOMINAL IRRADIATION BY COBALT-60 MOVING-STRIP TECHNIC. Luis Delclos, Ernest J. Braun, J. Raul Herrera, Vincent A. Sampiere, and Earl Van Roosenbeek (Univ. of Texas, Houston). Radiology, 81: 632-41(Oct. 1963).

There are several types of cancer which spread throughout the abdominal cavity, such as ovarian carcinomas, abdominal manifestations of the lymphomas, and sometimes seminomas with massive periaortic node involvement. In such cases the logical treatment is irradiation of the entire abdomen. Irradiation from the diaphragm to the pelvic floor could be done with orthovoltage, with long protraction at the expense of severe systemic reactions. With supervoltage, 3,000 rads can be given in six to seven weeks through parallel opposed portals but also with marked systemic reactions. By dividing the volume to be irradiated into a series of contiguous segments, with irradiation fields moved slowly from one end of the abdomen to the other (moving strip), one can deliver tumor doses up to 3,000 rads in twelve days to each segment. The whole course of treatment still takes six weeks, but the dose to any volume of tumor is delivered in twelve days and is therefore biologically more effective. Systemic reactions are much milder. (auth)

40468 RADIOAKTIVE SUBSTANZEN IN DER MEDIZIN. (Radioactive Substances in Medicine). Klaus Neumeister. Leipzig, VEB Deutscher Verlag für Grundstoffindustrie, 1963. 140p.

An introduction to the problems of nuclear medicine is presented. The characteristics of radiobiology and radiation protection are outlined. The areas in which treatment with radioisotopes and radiation is possible are indicated, and the properties and uses of various individual radioisotopes are summarized. Diagnostics and function studies with radioisotopes are also discussed. 103 references. (J.S.R.)

40469 RADIOAKTIVE ISOTOPE IN KLINIK UND FORSCHUNG. Band V. Vorträge am Gasteiner Internationalen Symposion 1962. (Radioactive Isotopes in the Clinic and in Research. Volume V. Lectures at the Gastein International Symposium, 1962). K. Fellinger and R. Hoefer, eds. Munich-Berlin, Urban & Schwarzenberg, 1963. 580p. DM 98.

Forty-six papers covering various medical uses of isotopes are included in this volume. Separate abstracts were prepared on 11 selected papers. One paper was previously abstracted and appeared in NSA. (C.H.)

40470 USE OF DIGITAL COMPUTERS IN BIOLOGICAL AND MEDICAL RESEARCH. G. L. Brownell and A. B. Callahan (Massachusetts General Hospital, Boston). p.1-7 of "Radioaktive Isotope in Klinik und Forschung. Band V." Munich-Berlin, Urban & Schwarzenberg, 1963. (In English)

The use of digital computers is becoming of increasing importance in biological and medical research. Applications of computers discussed include: analysis of tracer data by means of transform methods; correlation of clinical data with results of radioisotope scanning; statistical analysis of data on low levels of activity in normal pathology samples; Monte Carlo calculation of energy absorption in NaI crystals; and Monte Carlo calculation of radiation dose in tissue irradiated with gamma rays from point or distributed sources. (C.H.)

40471 USE OF A DIGITAL COMPUTER IN THE ANALYSIS OF WEAKLY RADIOACTIVE MIXTURES. R. E. Bentley (Royal Cancer Hospital, London). p.8-18 of "Radioaktive Isotope in Klinik und Forschung. Band V." Munich-Berlin, Urban & Schwarzenberg, 1963. (In English)

Gamma-spectrometric data from mixtures of up to 10 nuclides have been analyzed with the aid of a Ferranti Mercury Computer. A poly-multi regression method is used to correlate each unknown spectrum with a series of standard spectra. For each nuclide, a quantitative estimate and standard deviation is obtained. Non-significant nuclides are then eliminated and the calculation is repeated. Originally developed for the assay of naturally occurring radioactivity, the technique is equally suitable for clinical tracer experiments. Emphasis has been placed on the application of the method to weakly radioactive mixtures and to the problem of measuring a small concentration of a certain nuclide in the presence of larger amounts of other nuclides. An extension of the program was written to estimate the minimum measurable quantity in a variety of circumstances. This may also be used to investigate the maximum instrumental drift which can be tolerated and the magnitude of error introduced by differences in source geometry. (auth)

40472 INVESTIGATIONS ON RADIOIODINE KINETICS, ESPECIALLY THE INITIAL IODIDE PHASE IN THE THYROID GLAND, USING AN ELECTRONIC SIMULATOR. H. Schepers (Universität, Bonn) and C. Winkler. p.19-26 of "Radioaktive Isotope in Klinik und Forschung. Band V." Urban & Schwarzenberg, 1963. (In German)

An analog computer was designed to determine the influence of some variables, for example renal clearance, distribution rate of a tracer dose in the iodide space, or extrathyroidal radioactivity, on the measurements of the initial iodide phase. The kinetics of the initial iodide phase were based on a four-parameter system and the electronic details simulating biological factors include the amount of radioiodide simulated by charge; concentration of radioiodide simulated by voltage; and distribution spaces simulated by condensers. Using this apparatus it was possible to demonstrate that physiological variations of the parameters are of negligible influence on thyroidal radioiodine uptake measurements only. Furthermore, it was possible to determine the necessary corrections when conditions are unphysiological. Technical and physical details of the analog computer are discussed, and other possible applications of the apparatus are described. (C.H.)

40473 RECORDING AND PROCESSING RADIOCARDIOGRAMS FOR ANALOG COMPUTER ANALYSIS. L. Donato, R. Bianchi, R. Giordani, and I. Mannelli. (Università, Pisa, Italy). p.27-42 of "Radioaktive Isotope in Klinik und Forschung. Band V." Munich-Berlin, Urban & Schwarzenberg, 1963. (In English)

The radiocardiographic curve obtained after RI^{131}HSA injection into the right atrium can be adequately described in terms of an analog model of the cardio-pulmonary circulation. The following characteristics were used: right and left ventricles; mixing volumes with constant fractional rates of emptying; pulmonary circulation; distribution of pulmonary circulation times such that the distribution of the inflow into the left ventricle of a slug of radioactivity injected into the pulmonary artery follows a Poisson-like distribution of probabilities. Operating on the basis of this model on the precordial curve which represents the passage of RIHSA through the cavities of the right heart, the computer yields a left curve which fits the experimental one. Particular attention was devoted to the problem of obtaining undamped records of rapid changes of the amount of radioactivity in front of the counter. An instrument is described, called a periodic integrator, that provided direct undamped records of changing counting rates. With this method, the values of right and left ventricular blood volumes and of the volume of blood in the pulmonary circulation were obtained in normal subjects and patients with cardiopulmonary disease. (auth)

40474 TRITIUM GAS (H_2^3) AND KRYPTON-85 USED FOR THE DETERMINATION OF CIRCULATORY SHUNTS AND CARDIAC OUTPUT. N. A. Lassen (Bispebjerg Hospital, Copenhagen). p.80-7 of "Radioaktive Isotope in Klinik und Forschung. Band V." Munich-Berlin, Urban & Schwarzenberg, 1963. (In English)

Inhalation of inert gases and blood sampling from the right side of the heart can be used to identify even small left-to-right shunts. Intravenous injection of a physical solution of radioactive inert gases dissolved in saline, and sampling from the arterial blood allows the identification of right-to-left shunts. Injection of such dissolved gases combined with sampling from the pulmonary artery allows the measurement of cardiac output continuously in man. Krypton-85 has been used in most studies by the technique described by Munck. The use of tritium-gas (H_2^3) was investigated. The analysis used was based on proportional counting of tritiated methane. The low solubility of H in blood makes tritium especially well suited for the determination of very small right-to-left shunts. Combining

tritium with Kr^{85} further increases the sensitivity. Some results obtained in normals, in emphysema, and in liver-cirrhosis (intrasplenic injections) are discussed and other applications of radioactive inert gases are briefly reviewed. Various blood flow measurement techniques, a new method for the determinations of local blood flow applied to the cerebral cortex [Lassen and Ingvar, Experientia, 17: 42(1961)], external counting over the precordium for estimation of the residual blood volume of the right heart, and the demonstration of counter-current-diffusion in the renal medulla are discussed. (C.H.)

40475 THE PREPARATION AND USE OF RADIOACTIVE OXYGEN, CARBON MONOXIDE, AND CARBON DIOXIDE FOR INVESTIGATION OF REGIONAL LUNG FUNCTION, AND THEIR COMPARISON WITH XENON-133. C. T. Dollery, J. F. Fowler, P. Hugh-Jones, C. M. E. Matthews, and J. B. West (Hammersmith Hospital, London). p.88-104 of "Radioaktive Isotope in Klinik und Forschung, Band V." Munich-Berlin, Urban & Schwarzenberg, 1963. (In English)

Oxygen-15 (2-min half life) and C^{11} (20-min half life) were used to produce labeled O, CO, and CO_2. The preparation of the gases, the activities available, and the doses absorbed by organs are discussed. Following a single breath of the gas the ratio of peak activity of O^{15} in different regions is used as a measure of ventilation. The rate of removal of the radioactive gas from a given lung region during breath-holding is the net result, firstly of transfer of gas from alveolus into pulmonary capillary blood, and secondly of washout of the labeled blood from the counting field by the blood flow. Oxygen-15-labeled CO_2 completes the first stage very rapidly and therefore can be used to measure the rate of blood flow. Oxygen and CO are transferred from alveolus to blood more slowly but the observed clearance rate can be used in principle to obtain the alveolar gas transfer rate. Xenon-133, with a low solubility when injected intravenously, is rapidly evolved into alveolar air and can be used to measure proportion of total blood flow going to a region. In the upright position the blood flow is small at the upper zone of the normal lung and steadily increases towards the lower zone. There is a similar but smaller difference in the O uptake and diffusing capacity. Pulmonary hypertension abolishes the difference between the two zones, and patients with severe mitral stenosis have the flow distribution reversed so that more blood flows through the upper than the lower zone. Patients with generalized lung disease, for example emphysema, may show striking regional abnormalities of ventilation and blood flow. (auth)

40476 THE RESORPTION OF RADIOXENON FROM THE DUODENUM. O. Andrysek, J. Andryskova, and J. Setka (Charles Univ., Prague). p.152-60 of "Radioaktive Isotope in Klinik und Forschung. Band V." Munich-Berlin, Urban & Schwarzenberg, 1963. (In German)

The development of an isotopic method for the examination of the portal circulation using γ-emitting radioactive gases is described. The activity curves measured over the heart following intraduodenal insufflation of Xe^{133} depends in principle upon the portal circulation. The diffusion of the inert gas through the intestinal wall depends upon physical factors. The activity curves over the heart were measured in dogs following intraduodenal and rectal insufflation of the radioactive gas. Specific activity curves of the Xe^{133} were performed in the blood of the portal vein, the right heart, and the carotid artery of the dog after insufflation. These were also performed in normals, cirrhotics, and patients with malabsorption syndrome. A significant decrease in inert gas absorption was observed in patients with abnormal portal circulation due to cirrhosis. (auth)

40477 THE QUANTITATION OF MAGNESIUM, MANGANESE, ZINC, AND COPPER IN BLOOD BY NEUTRON ACTIVATION ANALYSIS. W. F. Bethard, R. A. Schmitt, and D. A. Olehy (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.222-36 of "Radioaktive Isotope in Klinik und Forschung. Band V." Munich-Berlin, Urban & Schwarzenberg, 1963. (In English)

Divalent cations are known to be necessary co-factors in many biochemical reactions. Magnesium, in particular, is essential for many reactions in anaerobic glycolysis; and energy production by anaerobic glycolysis is paramount to red blood cell viability during blood bank storage. Thus, the cation content of stored erythrocytes may have an important bearing upon their longevity. Quantitative analytic methods for most cations have not been sufficiently precise for measurement of trace elements in biological material. As a result, little knowledge exists concerning the role of such elements in the etiology or treatment of various diseases. The recent availability of a high-flux, safe, nuclear reactor has made possible the application of neutron activation techniques to trace element analysis. A method was devised for the quantitation of Mg, Mn, Zn, and Cu in blood. Erythrocytes or serum are placed in the reactor and exposed to a neutron flux of 1.8×10^{12} neutrons/cm^2/sec for approximately 20 min. Following bombardment appropriate carrier solutions are added, radiochemical separations are done, and the resulting radioisotopes are measured against simultaneously irradiated standards. Radioisotope identification can be accomplished both by half-life analysis and by γ spectra. Normal values for Mg, Mn, Zn, and Cu in erythrocytes and serum are presented. Preliminary data on the alterations of these resulting from the use of different anticoagulants, as well as during blood bank storage, are presented. (auth)

40478 RETICULOENDOTHELIAL FUNCTIONS IN MAN. TRACER STUDIES WITH COLLOIDAL SUSPENSIONS OF HUMAN ALBUMIN I^{131}. G. V. Taplin, E. K. Dore, and D.E D. E. Johnson (Univ. of California, Los Angeles and County Harbor General Hospital, Torrance, Calif.). p.346-61 of "Radioaktive Isotope in Klinik und Forschung. Band V." Munich-Berlin, Urban & Schwarzenberg, 1963. (In English)

Colloidal suspensions of albumin I^{131} were used as the tracer material to estimate liver blood flow. Identical preparations of unlabeled albumin were administered in loading doses prior to the tracer to test phagocytic function of the reticuloendothelial system (RES). Blood disappearance half time values ($T^1/_2$ in minutes) were determined externally by γ scintillation counting techniques for both tests. However, since phagocytic function depends on blood flow past the Kupffer cells as well as on the capacity of these cells to remove particulate material from the circulation, the ratio of the $T^1/_2$ for the tracer plus the load divided by that of the tracer alone was used as the index of phagocytic function. Such a correlation is necessary in cirrhosis with impaired portal circulation, and is important also as a routine to adjust for normal variations in hepatic blood supply. Corrected phagocytic indices were determined serially in control subjects and in patients with acute and chronic bacterial and viral infections, in Hodgkins disease, cirrhosis, myxedema, leukemia, infectious arthritis, recurrent furunculosis, neurodermatitis, and in pulmonary tuberculosis when the lesions were either receding or advancing. Auxiliary studies included concurrent measurements of

serum gamma globulin, red cell sedimentation rates, C-reactive protein reactions, blood cholesterol levels, and clinical estimates of the patient's resistance or susceptibility to infection. Phagocytic function test results were compared with findings from related tests. The significance of abnormal phagocytic test results were evaluated by the degree of deviation from the normal range establishment in suitable control subjects and by their relation to the clinical status of the patients in each of the several disease categories studied. (auth)

40479 WHOLE BODY COUNTING TECHNIQUES IN GASTRO-INTESTINAL ABSORPTION STUDIES. E. H. Belcher (Postgraduate Medical School, London). p.464-74 of "Radioaktive Isotope in Klinik und Forschung. Band V." Munich-Berlin, Urban & Schwarzenberg, 1963. (In English)

Whole-body counting techniques made possible the direct measurement of the fraction of an oral test dose of a radioactive material which is absorbed and retained in the body. A whole-body counting system comprising a single uncollimated NaI crystal scintillation detector mounted in a low background room and coupled to a single channel pulse height analyzer and scaler was used in clinical investigations of the gastrointestinal absorption of various substances. These include Co^{58}-labeled vitamin B_{12}, Br^{82}-labeled triolein, Ca^{47}, and Fe^{59}. Measurements were made using a "standard chair" technique. Results are presented which illustrate the potentialities and limitations of whole-body counting in such investigations, with particular reference to problems of calibration and to the effect of changes in distribution of radioactive material within the body on counting efficiency. (auth)

40480 STUDIES OF CELL POPULATION KINETICS IN NORMAL AND CONTINUOUSLY IRRADIATED ANIMALS. L. F. Lamerton, B. I. Lord, and H. Quastler (Royal Cancer Hospital, London). p.493-501 of "Radioaktive Isotope in Klinik und Forschung. Band V." Munich-Berlin, Urban & Schwarzenberg, 1963. (In English)

Using tritiated thymidine as a marker for dividing cells, with autoradiographic and assay techniques, a study was made of cell turnover in various tissues, particularly the gut and the blood-forming organs, of normal rats and of rats exposed to continuous γ irradiation over a range of dose-rates. The results are discussed in relation to problems of normal homeostasis and of changes produced by irradiation. (auth)

40481 IMPROVEMENTS IN OR RELATING TO PHARMACEUTICAL CAPSULES COMPRISING RADIOACTIVE MATERIALS. (to Abbott Labs.). British Patent 938,828. Oct. 9, 1963. Priority date Oct. 4, 1960, United States.

A pharmaceutical capsule formed of a non-toxic, water-soluble, thermoplastic material and containing a solid composition that melts at approximately 37°C, is compounded from a pharmaceutically acceptable oil and wax, and contains a radioactive compound is presented. The radioactive material is suspended in oil and sealed in the wax-like capsule. (C.E.S.)

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Refer also to abstract 41176.

40482 (HW-SA-3085) TOXICITY OF SIGNIFICANT RADIONUCLIDES IN LARGE ANIMALS. R. O. McClellan and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Aug. 16, 1963]. Contract AT(45-1)-1350. 36p. (CONF-264-1)

From Conference on Veterinary Toxicology, New York, July 1963.

The biological availability and potential hazards from the ingestion of fallout fission products by domestic animals are discussed. Results are reported from studies on the effects of continuous ingestion of Sr^{90} in miniature swine and I^{131} in sheep. Miniature swine fed low levels of Sr^{90} showed no observable effects during their first 4 years of life. It is pointed out that under normal agricultural practices, swine are sent to market at about 6 months of age and are rarely kept for breeding stock past 2 years of age. It is concluded that the level of Sr^{90} ingestion by the standard domestic pig would not be enough to impair either growth or reproduction. An average contamination of about 0.02 μC I^{131}/lb of vegetation eaten by adult sheep did not impair growth or reproduction of the animal or its offspring. (C.H.)

40483 (NP-13169) ON THE NUTRITIVE VALUE OF THE MAJOR NUTRIENTS OF IRRADIATED FOODS AND APPRAISAL OF THE TOXICITY OF IRRADIATED FOODS. Progress Report No. 23, September 1, 1962–March 1, 1963. Roberta Bleiler Hill, Sancia Gaetani, and B. Connor Johnson (Illinois. Univ., Urbana). Contract DA-49-007-MD 544. 6p.

A review and an evaluation of results from feeding trials in rats fed irradiated beef are given. It is concluded that irradiated beef is perfectly safe for consumption by man in a varied dietary regimen. (C.H.)

40484 (NP-13172) HEART LESIONS IN MICE. Harry Monsen (Illinois. Univ., Chicago. Coll. of Medicine). Mar. 1, 1963. Contract DA-49-007-MD-794. 5p.

Irradiated and nonirradiated vitamin-supplemented diets to mice of two strains resulted in the development of very specific heart lesions involving primarily the left auricle. A summary is presented of studies made to identify the etiologic agent. No conclusions were reached. (C.H.)

40485 (NP-13174) PROGRESS REPORT FOR PERIOD ENDING MARCH 1, 1963. M. A. Ross and F. M. Garner (Armed Forces Inst. of Pathology, Washington, D. C.). 6p.

The statistical analysis of results of histological examination of tissues from 2990 rats, 297 dogs, and 39 monkeys did not show any histopathological lesions consistently associated with maintenance on a diet containing irradiated foods. Preliminary results are presented. (C.H.)

40486 (NP-13176) CAROTENE BIOPOTENCY IN RATIONS CONTAINING GAMMA-IRRADIATED CARROTS AND LIVER CYTOCHROME OXIDASE AND INGESTION OF IRRADIATED MEAT. Report No. 3, September 15, 1962–March 1, 1963. Ian J. Tinsley (Oregon. Agricultural Experiment Station, Corvallis). Oct. 1, 1962. Contract DA-MD-49-193-62-642. 6p.

A decreased growth rate and a decreased liver vitamin A content were observed in rats raised on a diet containing irradiated carrots. Investigation indicated that bacterial action during storage may have contributed to carotene biopotency and produced the effects observed. An investigation was made of the fatty acid composition of liver lipids of rats raised on diets containing irradiated pork in an effort to explain the increase in liver cytochrome oxidase content observed in animals raised on pork rations. It was concluded that cytochrome oxidase is inversely related to the level of tissue arachidonate. The relation of liver arachidonate, linoleic acid, and cytochrome oxidase levels is discussed. (C.H.)

40487 (NP-13179) LONG-TERM DOG FEEDING EXPERIMENT WITH IRRADIATED CHICKEN, BEEF AND JAM. Final Report, Section 2: Histopathology. Frank R. Blood, William J. Darby, George Elliott, et al. (Vanderbilt Univ., Nashville. School of Medicine). Apr. 15, 1963. Contracts DA-49-007-MD-779 and DA-49-193-MD-2286. 10p.

Dogs were maintained on a diet containing 35% of the solids as irradiated chicken, beef, or pineapple jam. An evaluation of growth, food consumption, feed efficiency, hematologic values, urine analysis, and histopathologic findings showed no indication that inclusion of irradiated foods in the diet was harmful. (C.H.)

40488 (NP-13233) THE EFFECT OF CONTROL-GROUND BEEF AND IRRADIATED 5.58 MEGARAD-GROUND BEEF CONSUMPTION ON REPRODUCTIVE PERFORMANCE IN THE BEAGLE. Progress Report No. 6, September 15, 1962–March 1, 1963. Thomas B. Clarkson and James R. Pick (Wake Forest Coll., Winston-Salem, N. C. Bowman Gray School of Medicine). Contract DA-49-193-MD-209A. 5p.

A diet containing radiation-processed ground beef as 35% of the solids had no effect on the body weight or reproductive performance of dogs. (C.H.)

40489 (SAM-TDR-63-38) THE ACUTE MAMMALIAN TOXICITY OF RARE EARTH NITRATES AND OXIDES. Technical Report. (Chicago. Univ. Air Force Radiation Lab.) Aug. 1963. Contract AF41(609)-1693. 6p. (AD-419188)

Results of acute toxicity studies on rare earth nitrates indicate that their acute toxicity is highly dependent on the route of administration. The nitrate salts were moderately toxic when given intraperitoneally to rats and mice and only slightly toxic when administered orally to rats. With the exception of the transition elements, for which the oral LD_{50} values were greater than 5,000 mg/kg, the compounds generally exhibited an increase in toxicity with increasing atomic weight. The light lanthanons are highly toxic to rats by the intravenous route. The nitrate salts of Ce, Pr, Nd, and Sm were from 7 to 11 times more toxic to females than to male rats. Erbium nitrate, a heavy lanthanon, did not show the marked sex difference in toxicity to rats. Rats were able to tolerate 1,000 mg/kg of the rare earth oxides given orally or intraperitoneally. (auth)

40490 (TID-18025) THE IN VIVO INCORPORATION OF TRITIATED CYTIDINE AND TRITIATED THYMIDINE BY THE CESTODE, HYMENOLEPIS MICROSTOMA. James A. Dvorak and Arthur W. Jones (Tennessee. Univ., Knoxville). [1962]. Contract AT(40-1)-1749. 14p.

The mouse bile duct cestode, Hymenolepis microstoma, was exposed in vivo in separate experiments to tritiated cytidine and tritiated thymidine, respectively. Nucleolar and nuclear labeling, by cytidine, and nuclear labeling, by thymidine, as revealed by autoradiographic methods, occurred in both host and cestode tissues. As expected, only mitotically or synthetically active nuclei were labeled, those of the neck, developing organs, and embryos of the cestode. Bile-duct epithelium and pancreatic acinar cells, autoradiographed as a control, showed the same degree and localization of cytidine labeling as the active cells of the cestode. The assimilation of cytidine and thymidine by direct absorption from the fluid contents of the bile duct implies that cestodes can absorb such materials from their immediate environment. (auth)

40491 (TID-18075) PRE- AND POST-NATAL TRANSFER OF Zn^{65}. Samuel A. Gunn, Thelma Clark Gould, and W. A. D. Anderson (Miami, Fla. Univ., Coral Gables. School of Medicine). [1963]. Contract AT(40-1)-2023. 14p.

Rodent progeny may be born with radioactive Zn, even if the only source of Zn^{65} is the male sire. Studies in rats showed that once the female is contaminated, there is ready transfer to the progeny pre-natally via the placenta and post-natally via lactation. Zn^{65} content of the progeny may be lessened by giving the radioactive pups a non-radioactive, foster mother. However, because of the slow rate of excretion of Zn^{65} by the young, more than 50% of the radioactivity detectable at birth is still present at 36 days of age. (auth)

40492 (TID-18790) DISTRIBUTION OF RADIONUCLIDES IN HUMAN TISSUES. Progress Report. Merril Eisenbud (New York Univ., New York. Medical Center). May 28, 1963. Contract AT(30-1)-1480. 53p.

Includes Appendices I and II which are cataloged separately.

The relative Cs^{137} and K^{40} content of various human organs was measured. Differences as a function of age and sex were determined. The content of Zr^{95} and Nb^{95} in lung specimens from fetuses through age 70 years was determined. Radioautograms were prepared of radioactive particles in fixed lung tissues and compared with the range of β particles from radionuclides known to exist in fallout. Comparison of radioautograms of lung sections and control sections led to the conclusion that only a few fallout particles are retained in human lung tissue. The number of radioactive particles in outdoor air samples was examined by radioautography of air filters. (C.H.)

40493 (TID-18790(App. I)) THE WEIGHT OF HUMAN THYROIDS IN NEW YORK CITY. Y. Mochizuki, R. Mowafy, and B. Pasternack (New York Univ., New York. Medical Center). 10p.

A total of 762 thyroid glands from individuals of various ages with no history of thyroid disorder were weighed. Results show that the mean adult thyroid weighs 16.7 ± 6.9 g. The data suggest that 1% of New York City residents have thyroids that weigh about one-third of the mean. (C.H.)

40494 (TID-18790(App. II)) IODINE-131 DOSE TO HUMAN THYROIDS IN NEW YORK CITY FROM NUCLEAR TESTS IN 1962. M. Eisenbud, Y. Mochizuki, and G. Laurer (New York Univ., New York. Medical Center). 19p.

The I^{131} content was measured in 456 human thyroids dissected at autopsies of New York City residents with no known history of thyroid disease during the U. S. and U.S.S.R. nuclear weapons tests in 1962. Measurements were also made of 31 fetal thyroids including 5 cases in which the maternal thyroids were also available for post-mortem study. In vivo measurements were made of I^{131} in 11 normal adults who consumed known amounts of fresh milk contaminated with I^{131} from fallout. The average concentration of I^{131} in milk distributed in New York City was determined to be 38 pC/l from May 1962 to Jan. 1963. The maximum concentration was 370 pC/l in Sept. A thyroid dose of 40 Mrad was calculated to be the maximum thyroid dose of I^{131} as a result of the 1962 nuclear tests. The weights of adult thyroids were 17.7 ± 6.4 g for males, 15.3 ± 6.4 g for females, and 1.5 ± 0.6 g for full term stillborn infants. It was estimated that a child who consumed one liter of milk per day received a thyroid dose of 140 Mrad of I^{131} from fallout. (C.H.)

40495 (TID-19389) THE USE OF RADIOISOTOPES IN STUDYING LIME-INDUCED CHLOROSIS. Period Covered: February 28, 1962 to May 31, 1963. (Utah State

Univ., Logan and Utah. Agricultural Experiment Station, Logan). Contract AT(11-1)-1055. 322p.

Includes three theses cataloged separately.

Progress is reported in tracer studies on lime-induced chlorosis in plants. The influence of various factors on the movement of isotopes into roots and along xylem was studied in Zea mays using nutrient solutions containing $Fe^{59}Cl_3$ or $P^{32}O_4^{3-}$. A list is included of publications covering results of research performed under this contract. Separate abstracts were prepared on 3 dissertations included as appendices. (C.H.)

40496 (TID-19389(App. A)) DIFFERENTIATION BETWEEN THE pH EFFECT IN CAUSING LIME-INDUCED CHLOROSIS (thesis). Hyrum Del Var Petersen (Utah State Univ., Logan). 92p.

The interactions of P, HCO_3^-, and Fe on the internal inactivation of Fe was studied in soy beans and red kidney beans. By using a Ca-saturated resin as a buffering agent, it was possible to differentiate between the pH effect and the bicarbonate effect in causing Fe chlorosis. It was concluded that HCO_3^- had an effect in causing Fe chlorosis above that of pH only when it was associated with Fe. The effect was increased when HCO_3^-, Fe, and P were together. The distribution and concentration of nutrients and plant weights differed in chlorotic and nonchlorotic plants. (C.H.)

40497 (TID-19389(App. B)) THE EFFECT OF CHELATES ON PHOSPHORUS AVAILABILITY AND MOBILITY (thesis). Salah Ahmed Tahoun (Utah State Univ., Logan). 121p.

The effect of applied chelates on solubility, mobility, and availability of P was studied in tomato plants. Possible interactions of P with Fe were also studied. It was found that chelate increased P availability to the plant. Iron absorption was decreased by increasing P levels. Hydrogen chelate increased Fe uptake more than Fe chelate. Chelate decreased ion concentration if low concentration of chelate was used while ion concentration was increased if high concentration of chelate was used. The mechanisms by which chelate exerts its effect on P uptake by plants are discussed. (C.H.)

40498 (TID-19389(App. C)) EXPERIMENTS ON THE ORIGIN AND NATURE OF A ZINC DEFICIENCY IN FIELD BEANS ON A PORTANEUF SOIL AS DETERMINED BY THE APPLICATION OF ZINC^{65} (thesis). Edgar Dale De Remer (Utah State Univ., Logan). 87p.

A study was made of soil constituents that inactivate applied Zn under conditions of marginal native soil Zn. Additions of organic matter in the form of sugar beet tops to a soil low in Zn tended to make the Zn present in the soil more difficult for field beans to acquire. This deficiency was overcome by a foliar spray of $ZnSO_4$. It was concluded that when a soil is on the borderline of sufficiency or deficiency of Zn, very little change in management practices is required to upset the balance of the soil to the point where plants are unable to acquire sufficient Zn from the soil. (C.H.)

40499 USE OF INTERNAL SCINTILLATION STANDARDS IN HETEROGENEOUS COUNTING SYSTEMS. Ben Bloom (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). Anal. Biochem., 6: 359-61(Oct. 1963).

To compare the results obtained from the assay of potassium gluconate in a thixotropic gel powder phosphor system (TGP) with those obtained from the hexose degradation procedure, the relative H^3 and C^{14} efficiencies of the individual systems were evaluated using toluene-H^3 and toluene-C^{14} as the internal scintillation standards (ISS). Three samples of radioactive potassium gluconate were prepared from glucose-6-H^3, glucose-6-C^{14}, and glucose, C^{14} by the method of Moore and Link. The salts were ground; suspended in toluene containing TGP, PPO, and POPOP; and assayed for radioactivity. Samples of three radioactive potassium gluconates were also converted to gluconic acid and the aqueous solutions reduced to thick syrups, which were then taken up in Hyamine. Counting was done in PPO and POPOP. Following counting of the samples, 20 μl of toluene-H^3 and 20 μl of toluene-C^{14} were added to the sample to determine the relative efficiencies of the two counting systems. Data based on the activities of the internal scintillation standards indicate that the TGP system is the more efficient of the two systems with respect to both H^3 and C^{14}. However, inspection of the data obtained with the radioactive potassium gluconate and gluconic acid samples indicates that the Hyamine system is more efficient for both H^3 and C^{14}. (H.M.G.)

40500 COMPUTATION OF THE EXCRETION OF INCORPORATED RADIOACTIVE MATERIALS FOR THE ESTIMATION OF RADIATION PROTECTION MEASURES IN CLINICS. W. Schwarzer (Technischer Uberwachungs-Verein Rheinland e. V., Aachen). Atomwirtschaft, 8: 427-32(July-Aug. 1963). (In German)

While it is possible during the operation of an isotope station to obtain the technical data relevant to radiation protection chiefly by measurement it is necessary in planning such an installation to get this data by calculation. Computational functions are given for the time dependence of the activities concerned in the use of open radioactive substances in diagnosis and therapy. From these time functions are deduced the data for the size of the station, the proportions of the screening and the layout of the waste water decontamination plant which are necessary as a basis for construction. As an example the calculations for the radioisotopes Au^{198}, I^{131}, and P^{32} are worked out numerically and the results presented diagrammatically. From these considerations new points of view emerge for the duration of the minimum time the patient has to spend, after incorporation of radioactive materials, in the isolated isotope division of the clinic or in his sick room as well as for the screening of the wards. (auth)

40501 EFFECT OF OXIDIZED NICOTINAMIDE-ADENINE DINUCLEOTIDE ON HYDROGEN-DEUTERIUM EXCHANGE OF YEAST ALCOHOL DEHYDROGENASE AS MEASURED BY INFRARED SPECTROPHOTOMETRY. As. Hvidt, J. H. R. Kaegi, and M. Ottesen (Carlsberg Lab., Copenhagen). Biochim. Biophys. Acta, 75: 290-2(Sept. 24, 1963).

The effect of oxidized nicotinamide-adenine dinucleotide on hydrogen–deuterium exchange of yeast dehydrogenase was measured by infrared spectrophotometry. Results indicate a change in the 3-dimensional structure of yeast alcohol dehydrogenase induced by the coenzyme. (C.H.)

40502 APPLICATIONS OF LOW LEVEL COUNTING TO STUDIES OF CALCIUM AND STRONTIUM METABOLISM IN HUMAN SUBJECTS. D. M. Taylor (Royal Cancer Hospital, London and Royal Marsden Hospital, London), N. G. Trott, M. G. Rinsler, and J. Vennart. Brit. J. Radiol., 36: 732-44(Oct. 1963).

Low level whole-body and sample-counting systems were used in simultaneous studies of the turnover of Ca^{47} and Sr^{85} in 10 patients undergoing radiotherapy for cancer at various sites not involving bone. The whole-body counter used in the double tracer studies consisted of four 11-cm

dia × 5-cm thick NaI(Tl) crystals set up in a Pb-lined room excavated in chalk, which has a low natural radioactive content; ancillary studies were made in a demountable clinical low background room shielded by 15 tons of chalk contained in about 700 polythene-lined three-ply paper bags. Excreta samples were measured on a low background 7.5 -cm dia × 7.5-cm thick NaI(Tl) crystal, and 100-channel pulse height analyzers were used to record spectral data. Activities administered ranged from 0.3 to 2.4 μC, the most convenient combination being 0.3 to 0.5 μC of each nuclide. Whole-body measurements, and the collection of excreta were carried out for about 10 days with each patient. Methods of analyzing the data are described and estimates of percentage retention R, at various times t, based on body counting and excreta measurements, are compared. Limitations imposed by naturally occurring radioactivity and by contamination are discussed. Retention data from this small, highly selected group, are presented as the power function $R_t = At^{-n}$; values of n, based on body counting, ranged from 0.08 ± 0.033 to 0.39 ± 0.047 for Ca^{47} and 0.20 ± 0.026 to 0.66 ± 0.052 for Sr^{85}, the higher values being found for patients having carcinoma of the breast. Values derived from excreta assay, while in general somewhat lower, showed the same trend. (auth)

40503 CONCENTRATIONS OF RADIOACTIVE AND STABLE CAESIUM IN BONE AND SOFT TISSUES. G. E. Harrison, Alice Sutton, K. B. Edwards, and Hilda Shepherd (Medical Research Council, Harwell, Berks, Eng.). Brit. J. Radiol., 36: 745-8(Oct. 1963).

The concentrations of both stable Cs and radioactive Cs^{137} were measured in human tissues from individuals who died in England during 1956 or in the 12 months February 1960 to February 1961. The concentration of stable Cs in bone was found to be of the same order as that for soft tissue, viz., 9 to 20 ng/g wet weight. Radioactive Cs^{137} was measurable in only two of the 16 samples of femoral bone, while in liver and muscle the concentration ranged from 0.03 to 0.16 pC/g wet weight. It is estimated that from 2 to 7% of the body Cs (radioactive or stable) is located in calcified bone. If 6% of the total body Cs^{137} is in the skeleton it is estimated that in 1960 the mean radiation dose to bone from Sr^{90}, compared with that from Cs^{137}, was about 50 times greater in children and some five times greater in adults. (auth)

40504 SOME ASPECTS OF HUMAN BONE METABOLISM DEDUCED FROM STUDIES OF RADIUM CASES. R. E. Rowland (Univ. of Rochester, N. Y.). Clin. Orthopaed., No. 28, 193-203(1963).

Results were obtained from a study of more than 30 radium cases, and special attention was given to the diffuse distribution of Ra^{226} in bone. From examinations of a large number of labeled osteons, a reasonable guess can be made as to length of exposure to radium. The diffuse distribution is formed as a consequence of many processes: exchange phenomena, new bone formation, and secondary mineralization. Microscopic radium concentrations in the various deposits within the bone mineral are listed. From such measurements it was shown that hot spot to diffuse ratio is inversely dependent upon time. Uptake of radium by young, lowly bone is several times that of older, more fully mineralized bone, but is at least an order of magnitude less than that of forming bone. Detailed study of strip film autoradiographs and the corresponding microradiographs of radium-labeled bone suggest that even after a residence time of many years, there exists an anatomic integrity between the radium distributions and the structure of the bone. The pathway between bone mineral and the circulating fluids is the canalicular network which, though spreading from the central haversian canal throughout the entire osteon, is probably quite sharply limited at the bounding cement line. Thus exchange phenomena can only be expected to spread radium distributions throughout an anatomic unit such as the osteon, not across boundary lines. Transfer of radium from one unit to another must be through the blood. However, since in the blood plasma the radium concentration is well below that of the skeleton over most of a long burden time, there exists very little effective transfer of radium from one unit to another. (H.M.G.)

40505 BIOCHEMICAL STUDY OF THE RADIOSENSITIVITY OF THE SMALL INTESTINE TO X RAYS. I. ABSORPTION OF LIPIDS. J. R. Maisin, J. Dulcino, W. Verly, J. Deroo, and M. Lambiet (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Compt. Rend. Soc. Biol., 157: 916-19(1963). (In French)

The first results of a study on the absorption of fats during acute gastro-intestinal syndrome, occurring after irradiation, are reported. Three-month old C^+ mice were exposed on the stomach with x-ray doses of 600, 1500, and 2500 r. The third day after irradiation the mice received either by stomach tube or injection in the duodenum a diet containing glyceryl-tri-(palmitate-1-C^{14}) or H^3-palmitic acid giving an activity equal to 0.5 μc C^{14} or 1 μc H^3. The mice were sacrificed at different moments after administration of the diet. The results are given graphically and discussed. It was shown that the decrease in the absorption of fats, given by stomach tube, to mice receiving an abdominal irradiation of 1500 and 2500 r is essentially caused by gastric retention. In effect, when the fats are introduced directly in the duodenum, the absorption decrease observed in the irradiated mouse is not significant. There is no significant modification in the absorption of fats 13 months after irradiation with 600 r, whether they are given by stomach tube or duodenum injection. (J.S.R.)

40506 PERIVASCULAR EXTRAVASATION OF THORIUM DIOXIDE PREPARATION. TWENTY-ONE-YEAR FOLLOW-UP. Patricia Germon, John M. Howard, and Paul M. James (Hahnemann Medical Coll., Philadelphia). J. Am. Med. Assoc., 186: 437-8(Oct. 26, 1963).

The course of a patient is described with a 21-yr follow-up after the extravasation of ThO_2 preparation (Thorotrast) into the soft tissue of the arm. The resultant concentration of the Th in the spleen led repeatedly to the erroneous radiographic interpretation of splenic calcification. (auth)

40507 ULTRAFILTRATION OF CALCIUM AND STRONTIUM FROM SERA OF PATIENTS WITH PROTEIN ABNORMALTIES STUDIED WITH THE RADIOISOTOPE TECHNIQUE. Marianne Kara, Joseph Samachson, and Herta Spencer (Veterans Administration Hospital, Hines, Ill.). J. Clin. Endocrinol. and Metab., 23: 981-5(Oct. 1963).

The ultrafilterability of Ca and Sr from sera of patients with multiple myeloma and of patients with Boeck's sarcoidosis was studied by the use of tracer doses of Ca^{45} and Sr^{85}. The results were compared with those obtained with sera of normals. The average values of ultrafilterable Ca and Sr for normals were 55.1% for Ca^{45} and 67.1% for Sr^{85}, with an average Sr^{85}/Ca^{45} ratio of 1.22. The filtration of Ca^{45} from sera of patients with multiple myeloma was somewhat higher than that of normals, and the ultrafiltration of Sr^{85} was slightly but not significantly increased. This indicated decreased binding of both elements to the abnormal proteins. The Sr^{85}/Ca^{45} ratio was lower than that of normals because of the relatively higher filtration of

Ca^{45}. Sera of patients with Boeck's sarcoidosis with normal and abnormal serum protein distribution had approximately the same filterability of Sr^{85} as normals and a lower filterability of Ca^{45} (at a 5% level of significance). However, the lower filterability of Ca^{45} was suggestive rather than diagnostic because of the heterogeneity of this group of patients and the variability of Ca^{45} filtration from patient to patient. The results of the ultrafiltration studies with Ca^{45} are in good agreement with those obtained with stable Ca and with larger amounts of ultrafiltrate. (auth)

40508 LABELED IODOALBUMIN IN THE PLASMA IN THYROTOXICOSIS AFTER I^{125} AND I^{131}. John B. Stanbury and M.-A. Janssen (Harvard Univ., Boston and Massachusetts General Hospital, Boston). J. Clin. Endocrinol. and Metab., 23: 1056-8(Oct. 1963).

The appearance of iodoalbumin in the serum of eight out of nine thyrotoxic patients was observed after 1- to 1.5-mC doses of I^{125}, and after therapeutic doses of I^{131} in all. In all cases iodoalbumin was demonstrated, but in seven there was more after the therapeutic dose. Since this dose of I^{125} delivered a radiation dose considerably smaller than from the I^{131} tracer doses previously used with similar results, the findings are further evidence that the appearance of iodoalbumin is not entirely a radiation effect on the thyroid. Nevertheless, therapeutic doses of I^{131} seem to increase the quantity appearing in the plasma of some patients. (auth)

40509 THE MECHANISM OF ACTION OF AET. V. THE DISTRIBUTION AND THE CHEMICAL FORMS OF 2-MERCAPTOETHYLGUANIDINE AND BIS(2-GUANIDOETHYL) DISULFIDE GIVEN ORALLY IN PROTECTIVE DOSES TO MICE. George Kollmann, Bernard Shapiro, and Emanuel E. Schwartz (Albert Einstein Medical Center, Philadelphia). Radiation Res., 20: 17-23(Sept. 1963).

The distribution and chemical forms of 2-mercaptoethylguanidine (MEG) and bis(2-guanidoethyl) disulfide (GED) in the various tissues of 8- to 10-week-old C57Bl male mice 30 min after an oral radiation protective dose of 400 mg of MEG-S^{35} and GED-S^{35}/kg were studied. At 30 min after oral administration of MEG or GED, a significant amount of protective agent remained in the gastrointestinal tract. This accounts for some of the differences in $LD_{50(30)}$ values for equal doses of protective agent by oral and intraperitoneal routes. MEG was absorbed from the intestines more rapidly than GED, and protective forms appeared in the tissues in higher concentration after MEG administration. This explains the better protection provided by oral MEG as compared with oral GED at 30 min. The difference in absorption rates of MEG and GED may be useful in controlling the speed of onset and duration of protection by these agents in mice. (auth)

40510 THE DISTRIBUTION AND BIOLOGICAL EFFECT OF RADIOISOTOPES ENTERING THE ORGANISM THROUGH INHALATION AND INTRATRACHEALLY. Yu. I. Moskalev, L. A. Buldakov, L. N. Burykina, V. N. Streltsova, and D. I. Semenov. Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/67, 21p. (CONF-104-46). (In Russian)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Data on the distribution of Cs-137, Sr-89 and -90, Y-91, Ce-144, Zr-95, Nb-95, and Ru-106 entering the body through inhalation, and on the biological effects of Ce-144, Sr-89, and Ru-106 introduced intratracheally are presented. Experiments were carried out on 312 rats of both sexes and 5 dogs. It is shown that 10 to 18% of the inhaled activity is observed in the lungs a few minutes after inhalation of the aerosols. A small proportion of the activity (up to 5%) comes out of the lungs into the oral cavity and is ingested. With inhalation of Y, Ce, Zr, Nb, and Ru, which are poorly absorbed from the gastro-intestinal tract (0.05 to 0.2%), accumulation in the organs is almost entirely by means of absorption through the lung tissues. Cs and particularly Sr are extremely quickly absorbed from the lungs, while Ce and Ru are absorbed slowly. Sixteen days after inhalation, the lungs contain 3.5% Ce, 1.5% Ru, 0.15% Cs, and 0.003% Sr. With intratracheal uptake the biological effect of radioisotopes varies. Sr-90 gives no clinical or anatomical-pathological lung symptoms but gives the picture characteristic of bone-seeking isotopes. With Ce-144 and Ru-106, intratracheal uptake by rats and dogs causes, primarily, various lung injuries and diseases. (M.P.G.)

40511 THE EFFECT OF DIFFICULTLY SOLUBLE URANIUM COMPOUNDS ON THE ORGANISM WITH INHALATION. A. P. Novikova and M. G. Tikhaya. Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/69, 20p. (CONF-104-45). (In Russian)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

A study was made of the comparative effects of 2 samples of mixed oxides of U (U^{238} and U^{235}). The experiments were carried out on 10 dogs, who inhaled U dust for 300 min each day. The concentration of dust in the air was between 0.0310 and 0.0917 mg/l. The condition of the dogs was observed for 5 years. The functional state of the kidneys and liver, the morphology of the peripheral blood, and the elimination of U from the organism were studied. Dogs were sacrificed after 16, 23, and 56 months, and the organs of all the dead dogs were subjected to pathological and morphological investigation and to luminescent, radiometric, and histoautoradiographic analysis. The distribution of U^{235} was analogous to the distribution of U^{238}. The largest amount of the substances (per gram of tissue) was found in the lungs, the next largest amount in the bone and then the kidneys. Despite the fact that the U enters the mediastinal lymph nodes (where a second deposit is formed), and despite its elimination from the organism, U continued to be found in considerable quantities in the lung tissue over the 5-year period of observation. Autohistoradiographic work on the lungs showed a distinct irregularity in the accumulation of U. According to approximative calculation, the difference in specific activity between the least and most "covered" areas of the lungs was of the third to fourth order. The most important pathomorphological changes were found in the lungs and in the mediastinal lymphatic nodes. More serious damage was caused by uptake of U^{235} than of U^{238}. (M.P.G.)

40512 PECULIARITIES OF THE COURSE OF EXPERIMENTAL SILICOSIS WITH INHALATION OF RADON. V. S. Kushneva. Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/70, 21p. (CONF-104-43). (In Russian)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

An experimental study on the combined effects of quartzitic dust and Rn, which are basic hazards in the extraction of U ores, is reported. Comparative experiments were carried out on 180 white rats. Experimental silicosis was produced by introducing siliceous dust into

the lungs. A group of animals was also made to inhale doses of Rn in addition to the dust. A study of the data obtained from these investigations indicates that the most serious clinical symptoms are to be found in animals subjected to simultaneous exposure to siliceous dust and Rn. Pathological and anatomical investigation of the animals having undergone the influence of siliceous dust and those having experienced the combined effect indicated that there are considerable differences in the development of the pathological process, the most serious changes being noted in the lungs. In the animals subjected to simultaneous exposure, the process developed like the silicotic type, but in a more intensive, diffusive, atypical manner. The pathological process in the lungs resulting from inhalation of Rn does not disappear once inhalation ceases, but continues to develop for a prolonged period, leading to serious, irreversible, delayed consequences of the injury. Not the least important part in the process is played by the hard, active deposit (Ra A, Ra B, Ra C, etc.) formed as a result of radioactive disintegration of the radon. Experiments showed that the presence of dust in the lungs increases the danger of radioactive substances remaining in the body. (M.P.G.)

40513 THE TOXIC EFFECT OF URANIUM COMPOUNDS. V. A. Sanotskii, S. M. Mikhailovich, and A. T. Ivannikov. Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/68, 22p. (CONF-104-44). (In Russian)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The toxic effects of uranyl nitrate and U tetrafluoride was studied. Experiments were carried out on dogs, rabbits, and rats with subcutaneous and intratracheal administration, and results are reported. The clinical picture of the injury (general condition of the animals, weight, change in the peripheral blood and urine) and of various biochemical factors (cholesterol and its esters, and the nitrous fractions of the blood serum) was studied. Marked changes in the kidneys were observed, and pathomorphological changes in the organs with uranyl nitrate injury were studied. The distribution and elimination of U was studied in various cases of uranyl nitrate application. It was established that the skeleton of the animals acts as an important store of U (25 to 40%), as also do the kidneys (10 to 20%). In the liver a negligible amount of U is stored (tenths of a percent). With intratracheal administration, uranyl nitrate is very quickly absorbed from the lungs. After a day, it was found in quantities not exceeding 1 to 3% of the amount administered. In all cases of application, the U very quickly appears in the kidneys in large amounts. The U is eliminated from the body mainly with the urine. After the first day the elimination of U drops sharply and stays at a low level for a prolonged period. A decrease in the U content of the kidneys and skeleton takes place. After 6 months, about 1% of the administered amount remains in the kidneys and about 3 to 4% in the skeleton. On the basis of the experimental work carried out, it may be concluded that U poisoning is characterized by injury to the entire system. U cannot be regarded solely as a kidney poison. (M.P.G.)

Fallout and Ecology

Refer also to abstracts 41026 and 41079.

40514 (CEA-2317) ABSORPTION DE QUELQUES SELS PAR L'APPAREIL RADICULAIRE DE DIFFERENTES ESPECES LIGNEUSES ET ACCUMULATION AU COURS D'UN CYCLE VEGETATIF COMPLET. (Absorption of Some Mineral Salts by Root System of Different Woody Species and Accumulation over a Whole Vegetative Cycle). J. Gagnaire (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Grenoble). 1963. 33p.

The concentration power of plant tissues and the translocation speed of mineral salts vary considerably with the absorbed salt, the botanical species, the considered tissue, and the part of the vegetative cycle. In Grenoble, with Picea excelsa, the true dormance is short and is accompanied by a pre-dormance period and a post dormance period. In the vegetative period, Picea excelsa leaves concentrate less mineral salt than Acer campestris leaves (coefficient 2 for Ca—3 for phosphates) and Populus nigra leaves (coefficient 3 for Ca, coefficient 5 for phosphates). Results of tracer studies are tabulated. (C.H.)

40515 (HW-SA-2883) RADIOIODINE IN NORTH AMERICAN DEER AND CARIBOU THYROIDS FOLLOWING RUSSIAN NUCLEAR TESTS. W. C. Hanson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.); F. W. Whicker, and A. H. Dahl (Colorado State Univ., Fort Collins). [Jan. 29, 1963]. Contract AT (45-1)-1350. 6p.

I^{131} concentrations in thyroids of deer from Washington, Colorado, and Maryland and of caribou from Alaska were measured following the resumption of nuclear weapons tests by the USSR on September 1, 1961. Maximum concentrations occurred nearly two months after the first nuclear test and then decreased at an effective half time of about 15 days. Washington and Colorado deer thyroids contained the highest concentrations, Maryland thyroids were median, and Alaskan caribou thyroids contained lowest concentrations. (auth)

40516 (PNE-236P) FOOD-CHAIN RELATIONSHIPS OF IODINE-131 FOLLOWING TWO NUCLEAR TESTS IN NEVADA. Frederick B. Turner and William E. Martin (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). May 10, 1963. Contract AT-04-1-GEN-12. 70p.

The uptake and retention of radioiodine by thyroids of jack rabbits were studied in relation to deposition and persistence of radioiodine on native vegetation. Four areas were examined in the Sedan fallout pattern, and two in the less well-defined Small Boy pattern. In each of the four study areas contaminated by Sedan fallout, five or more stations were established. Plant samples and rabbits were collected near each station at 5-day intervals between D + 5 and D + 30 and again at D + 60. Plants, stomach contents, and thyroids were analyzed for radioiodine. Levels of radioiodine on plants collected from 20 to 30 miles north of Sedan ground zero 5 days after the test ranged from 0.1 to 22.4 mμC/g. In areas 40 miles north of ground zero, levels of from 0.4 to 3.7 mμC/g were encountered 5 days after the test. Seventy miles north of ground zero, levels ranged from 0.5 to 1.0 mμC/g 5 days after the test. In the most remote area examined, 110 miles north of ground zero, native vegetation showed levels of radioiodine ranging from 0.1 to 0.6 mμC/g 5 days after the test. The radioiodine was determined to be I^{131} by analysis of decay curves of samples counted repeatedly. Between 5 and 20 days after the test, the mean half time of I^{131} on vegetation was 5.5 days. Approximately the same rate of loss was observed in all four study areas. The rate of loss of radioiodine from plant samples after collection and processing was compared with the physical decay rate of I^{131} in order

to test the validity of decay corrections of counts made several weeks after collection (based on a half life of 8.04 days). Only a small number of samples were so analyzed and the results were inconclusive. However, there were indications that collecting and processing techniques might be advantageously modified in future studies to prevent loss of iodine by volatilization. Radioiodine analyses were made of the stomach contents of rabbits collected in the four study areas. The amount of I^{131} declined with distance from ground zero, but was lower than in plant samples collected 25 and 110 miles from ground zero and higher than in plant samples taken 40 to 70 miles from the crater. Iodine-131 in jack rabbit thyroids was greatest in the areas closest to ground zero and declined with distance. In areas about 20 miles north of ground zero, thyroid burdens ranged from 23 to 5931 mμC/g 5 days after the test. Forty miles from ground zero, thyroid radioiodine ranged from 10 to 2860 mμC/g at D + 5. At the same time, thyroid levels from 17 to 1126 mμC/g and from 21 to 203 mμC/g were observed 70 and 110 miles north of ground zero. Thyroid radioiodine declined with time in all areas. The assimilability of fallout radioiodine on native vegetation was estimated by artificial feeding experiments. Samples of native plants were returned to Los Angeles, analyzed for radioiodine content, and fed to Dutch rabbits in known amounts. Iodine-131 uptake and retention in thyroids ranged from about 2 to 12%. Mean uptake was significantly higher from samples taken within 20 miles of ground zero (12%) than from more remote areas (average of 3 areas was 3.5%). Comparison of observed levels of thyroid I^{131} with levels predicted by a mathematical model (based on measured contamination of vegetation and estimates of assimilability), showed that, in general, the observed levels were higher than those predicted. The discrepancies are great enough to imply either a flaw in the model used or a serious error in estimating one or more of the input parameters. The estimated parameters most likely to be in error are deemed to be the amount of radioiodine ingested and the efficiency of uptake and retention. Following the Small Boy test on July 14, radioiodine levels on vegetation in Delamar Valley, about 75 miles northeast of ground zero, ranged from 0.1 to 1.1 mμC/g. Near Fruitland, Utah, about 360 miles to the northeast, vegetation samples contained from 0.2 to 0.9 mμC/g and thyroids from 87 to 222 mμC/g, five days after the test. (auth)

40517 (SA/PR-40(Rev.)) BASIC ASSUMPTIONS FOR USE IN THE ASSESSMENT OF THE RADIOLOGICAL HAZARD TO FOOD FROM FALLOUT. (Gt. Brit. Home Office, London). [May 1962]. 4p.

The physical properties of fallout materials are reviewed from the standpoint of the contamination of growing crops to air- or ground-burst megaton bombs. It is pointed out that the most important isotopes from the point of view of food contamination are I^{131}, Sr^{89}, Sr^{90}, and Cs^{137}. All of these are formed from gaseous precursors that have not condensed when the heavy particles start to fall from an atomic cloud. They are therefore not found in abundance in mixed fission products in the heavily contaminated areas within 100 miles of ground zero. In the area of heavy fallout from ground-burst explosions, the size of the particles is such that they are not readily soluble and so their biological availability is low. The radioactivity of fallout is proportional to the volume or mass of the particle and the possibility of uptake by plants is decreased in proportion to particle size. The possibility of overlapping plumes of fallout from widely separated bombs is considered. Data are presented on the relation between the amount of isotope and dose rate for I^{131}, Sr^{89}, Sr^{90}, and Cs^{137}. Typical values and dose rates are given for an idealized 1–MT ground burst fallout pattern at various distances from ground zero. (C.H.)

40518 (TID-3910(Suppl.1)) TERRESTRIAL AND FRESHWATER RADIOECOLOGY: A SELECTED BIBLIOGRAPHY (SUPPLEMENT 1). Alfred W. Klement, Jr. and Vincent Schultz (Division of Biology and Medicine, AEC). Feb. 1963. 97p.

Pertinent references are presented to 927 recent publications in the field of radioecology of terrestrial and freshwater organisms. Emphasis is placed on publications since March 1962. References are arranged alphabetically by the name of the first author. Twenty-five of the references are listed separate from the others under the heading Bibliographies. (C.H.)

40519 (TID-7664) TRANSPORT OF RADIONUCLIDES IN FRESH WATER SYSTEMS. Report of a Working Meeting Held at University of Texas, Austin, January 30–February 1, 1963. B. H. Kornegay, W. A. Vaughan, D. K. Jamison, J. M. Morgan, Jr., eds. (Johns Hopkins Univ., Baltimore). July 1963. Contract AT(30-1)-1477. 406p.

Nineteen papers presented at the Conference on the Transport of Radionuclides in Fresh Water Systems are given. Separate abstracts were prepared for 18 papers; one was previously abstracted for NSA. (M.C.G.)

40520 (TID-7664(P.17-42)) PRELIMINARY SAFETY ANALYSIS OF RADIONUCLIDE RELEASE TO THE CLINCH RIVER. K. E. Cowser, W. S. Snyder, and M. J. Cook (Oak Ridge National Lab., Tenn.).

Progress made in assessing the degree of safety of radionuclides released to the Clinch River as practiced up to 1961 is summarized. The radionuclides released, concentrations of radionuclides in rivers, and avenues of human exposure are discussed. Doses to critical organs were calculated, and doses from drinking water, immersion in contaminated water, and from contaminated bottom sediments were estimated. Results are presented in graphs and tables. (M.C.G.)

40521 (TID-7664(p.43-60)) THE AQUEOUS BEHAVIOR OF STRONTIUM-85, CESIUM-137, ZINC-65, AND COBALT-60 AS DETERMINED BY LABORATORY TYPE STUDIES. Albert G. Friend (Robert A. Taft Sanitary Engineering Center, Cincinnati).

Two studies were made of the behavior of Sr^{85}, Cs^{137}, Zn^{65}, and Co^{60} in fresh-water systems, one in a completely artificial aquarial environment and the other in a semi-natural pond situation. The aquarial studies were designed to determine the effects of major cations in natural water system on the uptake of Sr, Cs, Zn, and Co by small bluegill fish. Only calcium was found to have any effect on strontium uptake. It depressed the strontium uptake as its aqueous concentration increased. The semi-natural study was carried out during the summer and fall of 1962 by injecting multiple radionuclides into a shallow fresh-water pond. Cs, Co, and Zn disappeared from the liquid phase rapidly, while Sr showed little loss from solution. Coagulation and filtration data indicated that in undisturbed pond water about 40% of the cobalt, 82% of the zinc, and 47% of the cesium are in particulate form or are associated with particulate matter in water, while only 4.2% of the strontium was so found. Analysis of pure clay samples immersed in the pond, however, showed that Sr^{85} reached the highest level of uptake. (M.C.G.)

40522 (TID-7664(p.61-70)) HETEROGENEOUS EQUILIBRIA IN SEDIMENT UNDER TRANSPORT. W. F. Bradley (Texas. Univ., Austin).

The minerals of heterogeneous composition include ions of varying valences, coordinated in varying degrees of tightness of bonds, and these impose the property that they have incongruent solubilities. It is postulated that the character of the crystals of the minerals permits a unified expression of the behavior of these minerals in dispersions. (M.C.G.)

40523 (TID-7664(p.71-90)) MINERALOGY AND EXCHANGE CAPACITY OF MODERN FLUVIAL SEDIMENTS. Vance Kennedy (Geological Survey, Denver).

A study was made of the variation of mineralogy and exchange capacity of stream sediments as related to grain size, stream discharge, time, geologic terrain, and geographic location. Samples of suspended sediment and bed material were obtained from 21 streams located in various parts of the United States. The eastern streams appeared to be characterized by kaolinite, illite, and dioctahedral vermiculite. In the western streams little, if any, dioctahedral vermiculite was found and the kaolinite content decreased. In place of these minerals montmorillonite and mixed-layer montmorillonite–illite were prominent constituents and the exchange capacity rose accordingly. It appeared that the rock fragment portion of the stream sand is responsible for much of the exchange capacity. The high exchange capacity of some of the silts indicated that grain aggregates are common in this size range also. The data available indicate that the exchange capacity of stream sediment can be quite important in controlling water composition. (M.C.G.)

40524 (TID-7664(p.91-112)) BEHAVIOR OF RADIONUCLIDES IN THE COLUMBIA RIVER. J. M. Nielsen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The distributions of radioisotopes from Hanford operations to the Columbia River were studied. Results are presented in graphs and tables. (M.C.G.)

40525 (TID-7664(p.113-25)) SORPTION AND RELEASE OF RADIONUCLIDES BY SEDIMENTS. Uel S. Clanton (Texas. Univ., Austin).

The uptake of radionuclides by sediments in fluvial and lagoonal environments was investigated in the Guadalupe River drainage basin. The clays contained in the sediment samples were weathered material that was transported in the stream system after developing by subaerial weathering of the parent rock in the soil zone. Ion exchange capacity measurements were determined by the barium saturation technique. Sr^{89} and Cs^{137} sorption studies were made on selected samples in order to determine the effects of mineralogy and exchange capacity on radionuclide uptake. Organic material sorbed on the clay surface increased the sorption capacity of the sediments. (M.C.G.)

40526 (TID-7664(p.127-48)) SORPTION AND RELEASE OF RADIONUCLIDES BY SEDIMENTS. Tom D. Reynolds (Texas. Univ., Austin).

A relation for the distribution of radionuclides in streams is presented. Stream sediment studies were made on the Guadalupe River and its receiving bodies of water, Lake Austin on the Colorado River, and Lake Falcon on the Rio Grande. Samples collected included bottom sediments, suspended sediments, and water samples. The sorption of radioisotopes was found to increase with increasing sediment concentration. Results are presented in tables and graphs. (M.C.G.)

40527 (TID-7664(p.149-59)) NATURE AND DISPOSITION OF SEDIMENT SORBED RADIONUCLIDES ENTERING SAN FRANCISCO BAY. Warren J. Kaufman and Peter C. Klingerman (California. Univ., Berkeley).

Studies were made of sediment transport in the San Pablo Bay portion of the San Francisco Bay system to determine sediment-sorbed fission product transport. Sediment labeled with Au^{198} was used under various circumstances and traced along the bottom by a sled-mounted underwater scintillation detector. The nature and amount of radioactive materials entering the Bay system were estimated by establishing a sampling system on the Sacramento River. Results are presented in graphs and tables. (M.C.G.)

40528 (TID-7664(p.161-91)) CLINCH RIVER STUDIES. Frank Parker (Oak Ridge National Lab., Tenn.).

Studies were made on the Clinch River to determine the fate of radioactive materials currently being discharged, to determine and define mechanisms of dispersion radionuclides released, to evaluate direct and indirect hazards of current disposal practices, to evaluate the capacity of the river for radioactive waste disposal, and to recommend long-term monitoring procedures. Results are presented in figures, tables, and graphs. (M.C.G.)

40529 (TID-7664(p.193-207)) ROLE OF BOTTOM ORGANISMS. Dan. J. Nelson (Oak Ridge National Lab., Tenn.).

Three modes in which organisms living in a river can affect the distribution or redistribution of radioactive materials are discussed. One is on tudificid worms. Another is on clams and their large concentration factor of Sr^{90}. The third regards aquatic insects and the possibility of their flying out of the river and contaminating the nearby landscape. It is shown that the effects of worm populations in the Clinch River are insignificant as far as the transport of sediment is concerned. The average Sr^{90} content in clams harvested was 7,019 $\mu\mu c/g$ shell. This would result in the annual removal of about 64 mc Sr^{90} from the river, while the release of Sr^{90} to the river from ORNL ranges from 29 to 150 c/yr. It was calculated that there is, currently, about 45 times as much fallout coming into the river as insects carry out. (M.C.G.)

40530 (TID-7664(p.209-29)) THE ELEMENT RATIO METHOD FOR PREDICTING BIOGEOCHEMICAL MOVEMENTS FROM METABOLIC MEASUREMENTS IN ECOSYSTEMS. H. T. Odum (Texas. Univ., Austin).

The method of relating a trace element to the main element carbon for predicting biochemical movements from metabolic measurements in ecosystems is described. A network circuit was developed for simulating quantatively the temporal behavior of the system. The method and its results for some examples are shown in figures and graphs. (M.C.G.)

40531 (TID-7664(p.231-46)) STRONTIUM UPTAKE BY ALGAE. John H. Austin (California. Univ., Berkeley).

Studies are being made to relate the assimilative capacity of natural waters to the environmental factors influencing the uptake of radionuclides by aquatic organisms at various tropic levels. Strontium uptake by a member of the first tropic level, the unicellular alga Chlorella pyrenoidosa, and the effects of calcium and magnesium on the mechanism and extent of uptake were investigated. The sorption process for strontium was rapid and was not limited by a metabolic process. The equilibrium concentration of the strontium activity on the cells was related to the ionic composition of the medium. (M.C.G.)

40532 (TID-7664(p.247-59)) ASPECTS OF BIOLOGICAL TRANSPORT OF PHOSPHORUS-32 IN STREAMS. Frank Hooper (Atomic Energy Commission, Washington, D. C.).

Studies were made of the biological transport and cycling of phosphorus in a stream near Cheboygan, Michigan. Time in minutes was plotted on a logarithmic scale to show the distribution of activity. First the water activity was highest. Next the periphyton activity was at a maximum, followed by filter feeders, browsers, detritus feeders, and fish. In years when there was a lot of activity in particulate form there were very high activities in the fish and in years when most of it was in soluble form, a much larger percentage of activity was found in periphyton and a lower percentage in fish. (M.C.G.)

40533 (TID-7664(p.261-7)) BIOLOGICAL TRANSFER OF NATURAL AND FALLOUT RADIONUCLIDES IN STREAMS. Louis A. Krumholz (Kentucky. Univ., Lexington).

Studies are being made on the natural radioactivity from the soils and the fallout that has accumulated in the Doe Run stream, 9½ miles long, in Meade County, Kentucky. The water, algae, mosses, rooted aquatic plants, invertebrate animals, and fish were studied. Radioactivity was accumulated by the various organisms throughout the length of the stream without any pattern of accumulation when the total aspect of the stream was considered. Following the beginning of the Russian tests, and then the American tests, there was around a 10- to 50-fold increase in the amounts of radioactivity accumulated by these organisms. (M.C.G.)

40534 (TID-7664(p.295-308)) DISPERSION MEASUREMENTS. Calvin C. Patterson (Texas. Univ., Austin).

Dispersion in the transport of nuclides was studied in a section of the Colorado River about 20 miles southeast of Austin and in the Pierce Canal, El Campo, Texas. Fluorometric techniques using fluorescent dyes and a fluorometer were chosen to collect data. Results are shown in graph form. (M.C.G.)

40535 (TID-7664(p.311-26)) TURBULENT DISPERSION OF MISCIBLE MATERIALS IN OPEN CHANNELS. Nobuhiro Yotsukura (Geological Survey, Washington, D. C.).

Theories of turbulent diffusion are reviewed. A rectangular flume about 150 ft long, 4 ft wide, and with side walls about 15 in. high was used in the laboratory studies. The flume has a recirculating system with a sump containing two million gallons of water. Miscible material was a mixture of hydrochloric acid and ethyl alcohol. Results are shown in graph form. (M.C.G.)

40536 (TID-7664(p.327-52)) TRANSPORT OF RADIONUCLIDES IN FRESH WATER: DISPERSAL OF BED SEDIMENTS. W. W. Sayre and D. W. Hubbell (Colorado State Univ., Fort Collins).

Studies are being made of the role of fluvial sediment in transporting and dispersing radionuclides, which are released into streams as radioactive wastes and subsequently sorbed on sediment particles. The limiting cases were considered: the dispersion and transport of sand-size particles that move as bed-material load and the dispersion and transport of extremely fine clay particles that move in a continuously suspended state. Equations are presented and graphs are given for real situations. (M.C.G.)

40537 (TID-7664(p.353-89)) A LEAST COST EVALUATION OF LOW LEVEL LIQUID ATOMIC WASTE TREATMENT-SIMPLIFIED DETERMINISTIC MODEL. W. O. Spofford, Jr. and H. A. Thomas, Jr. (Harvard Univ., Cambridge, Mass.).

The use of a simplified economic decision making process as applied to a water quality problem is illustrated. The general problem is discussed and the objective function, cost function for the treatment plants, mathematical development, and a numerical example are given. (M.C.G.)

40538 (TID-13358(1st. Rev.)) OFFSITE ECOLOGICAL RESEARCH OF THE DIVISION OF BIOLOGY AND MEDICINE— TERRESTRIAL AND FRESHWATER. Vincent Schultz, ed. (Division of Biology and Medicine, AEC). Mar. 1963. 127p.

The off-site program of the Environmental Sciences Branch of the Division of Biology and Medicine of the AEC is conducted throughout the U. S. through contracts with universities and colleges. Research programs in terrestrial and freshwater ecology are described. An alphabetical listing, by university or college, of research contracts current in March, 1963 gives summary information on the type of ecological research under investigation. Information is included on objectives, experimental procedures, and publications. Emphasis is placed on the fates and effects of fallout radionuclides in food chains and the effects of radiation on plant and animal communities. An index of participating colleges and universities and a list of the principal investigators are included. (C.H.)

40539 TICKS OF THE NEVADA TEST SITE. D. Elden Beck, Dorald M. Allred, and Elias P. Brinton. Brigham Young Univ. Sci. Bull., Biol. Ser., 4: No. 1, 1-11(Oct. 1963).

A study was made to determine kinds, population, seasonal occurrence, and geographical and ecological distribution of ticks in areas where nuclear detonations have taken place. The tick collections were principally from rodents and leporids found in valleys and lower elevations of the surrounding mesas and mountain ranges. Hosts, seasonal incidence, and plant community relationships are given for Argas persicus, Otobius lagophilus, Dermacentor albipictus, Dermacentor parumapertus, Haemaphysalis leporis-palustus, Ixodes angustus, Ixodes kingi, Ixodes ochotonae, Ixodes pacificus, Ixodes sculptus, and Ixodes spinipalpis. Of the 24 species of animals found infested with ticks, 17 were infested with larvae, 19 with nymphs, and only 6 with adults. (M.C.G.)

40540 THE DISTRIBUTION OF Sr^{90} AND Ru^{106} IN THE PRINCIPAL PARTS OF THE PINE TREE. G. I. Makhonina, P. I. Yushkov, M. Ya. Volkova, and N. V. Timofeev-Resovskii (Inst. of Biology, Ural Affiliate of the Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 151: 1456-7 (Aug. 21, 1963). (In Russian)

Sr^{90} and Ru^{106} were watered into a plot of ground. After a year, six young pine trees (Pinus Silvestris L) were selected, and various parts of the tree were ashed to determine the Sr^{90} and Ru^{106} distribution. The Sr^{90} concentration in the needles was almost always lower than in the bark and woody part. The bark of the stems contained 1.5 to 3.0 times more Sr^{90} than the cellulosic part, but was a factor of five lower than in the bark of the roots. The concentration of Sr^{90} in the root crust was a factor of 17 higher than in cellulosic part of the root. The distribution of Ru^{106} was more uniform. The concentration of Ru^{106} in the needles was a factor of 2.5 lower than in the crust, and a factor of 10 higher than in the cellulosic part of the stems and branches. The Ru^{106} content in 2 to 5 year old needles was a factor of 5 greater than in young needles. Ru^{106} concentrated readily in the bark of the tree. Almost one-half of

the strontium was accumulated in the roots, but only 4% of the ruthenium was found in the roots. In the above-ground part of the tree, Ru^{106} accumulated primarily in the needles and in the bark of the trunk and branches, while Sr^{90} accumulated primarily in the bark and cellulosic part of the trunk and branches. (TTT)

40541 RADIOAKTIVNYE PRODUKTY DELENIYA V POCHVE I RASTENIYAKH. (Radioactive Fission Products in Soil and Plants). I. V. Gulyakin and E. V. Yudintseva. Moscow, Gosatomizdat, 1962. 276p.

Plant uptake of fission products from soil and behavior of radioactive fission products in soil was investigated. Absorption and distribution of strontium and cesium in plants, influence of soil organic matter on mineral uptake, and experiments on soil decontamination are discussed. Effects of various radioactive products on growth and development of plants and retention of strontium and cesium in the edible parts of crop plants after foliar contamination are also considered. (R.V.J.)

Radiation Effects on Living Tissues

40542 (AD-296342) ELECTRICAL AND ELECTROCHEMICAL PROPERTIES OF MUSCLE CELLS SUBJECTED TO VARIOUS DOSES OF X-RADIATION. PART I. Adolfo Portela and Juan Carlos (Emory Univ., Atlanta). [1963]. Contract DA-49-193-MD-2256. 5p.

Preliminary results are reported from studies on the early effects of 100-kr x radiation on electric and electrochemical properties of skeletal muscles in frogs. Data are reported on relaxation time, ATP and glycogen content, fatigue, sodium and potassium content, oxygen consumption, twitch reflex, ATPase activity, oxidation phosphorylation, membrane permeability, and Na conductance. (C.H.)

40543 (AED-C-04-07) AUSGEWÄHLTES SCHRIFTTUM NACH SACHGEBIETEN. STRAHLENEINWIRKUNG AUF LEBENDES GEWEBE UND ORGANISMEN. BIBLIOGRAPHISCHE ZUSAMMENSTELLUNG. (Selected Literature According to Subject Field. Radiation Effects on Living Tissue and Organisms. Bibliographic Compilation). W. Stahlhofen, comp. (Max-Planck-Institut für Biophysik, Frankfurt am Main). 199p.

Seven hundred and ninety-two references on radiation effects on living tissues and organisms are presented. Report number, patent number, corporate author, personal author, and subject indexes are included. (M.C.G.)

40544 (AED-C-04-10) AUSGEWÄHLTES SCHRIFTTUM NACH SACHGEBIETEN. STRAHLENEINWIRKUNG AUF LEBENDES GEWEBE UND ORGANISMEN. BIBLIOGRAPHISCHE ZUSAMMENSTELLUNG. (Selected Literature According to Subject Field. Radiation Effects on Living Tissue and Organisms. Bibliographic Compilation). W. Stahlhofen, comp. (Max-Planck-Institut für Biophysik, Frankfurt am Main). Dec. 30, 1962. 273p.

One thousand, one hundred and fifteen references on radiation effects on living tissue and organisms are presented. Report number, author, and subject indexes are included. (M.C.G.)

40545 (BNL-7284) CYTOCHEMISTRY OF DELAYED RADIONECROSIS OF THE MURINE SPINAL CORD. Wolfgang Zeman (Indiana Univ., Indianapolis. School of Medicine and Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT-30-2-GEN-16. 41p. (CONF-235-1)

From 2nd International Symposium on Effect of Ionizing Radiation on the Nervous System, Los Angeles, Aug. 1963.

The temporal development of delayed radionecrosis of the murine spinal cord was studied by cytochemical techniques. It was shown that the necrosis is preceded by a significant rise in the mitotic activity of interstitial cells, together with marked alterations in the levels of enzyme activity. Some indication of increasing turnover of RNA was obtained, and these findings lend themselves to a hypothesis attributing delayed radionecrosis to a molecular disorganization of cellular constituents. (auth)

40546 (HW-SA-2950) THE DIFFERENTIAL SENSITIVITY OF FLOUR BEETLES, TRIBOLIUM CONFUSUM AND T. CASTANEUM TO X-RAY ALTERATION OF REPRODUCTIVE ABILITIES, INDUCED DOMINANT LETHALS, BIOMASS AND SURVIVAL. H. E. Erdman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Mar. 12, 1963]. Contract AT(45-1)-1350. 18p.

Single- and mixed-species populations of day-old flour beetles, T. confusum and T. castaneum, were established after exposure to 0, 2, 4, and 6 kr of x rays. Reproductive abilities, measured as the mean number of F_1 adults per female, for single-species populations of T. castaneum given 2 kr approached control values after one month, whereas, those of T. confusum persisted below controls. An exposure of 4 kr was almost sterilizing, over 90 and 99% sterilizing respectively for T. castaneum and T. confusum. Six-kr doses induced complete sterility in both species. Dominant lethals induced by 2-kr x rays were approximately twice as abundant in T. confusum as in T. castaneum. Increased fertility with time was considered evidence that undifferentiated gametes were more radioresistant than mature ones. Selective elimination of a flour beetle species (T. confusum) in coexistence was indicated at exposures greater than 4 kr of x rays but less than 6 kr. Interspecies antagonism and 2 kr of x rays, as an environmental stress factor, appeared additive in adversely influencing the reproductive ability of T. confusum. The dose-response curves for reproduction were linear up to 4 kr except for T. confusum. After 4 kr, the dose-response curves departed from linearity for both species. Biomass (standard dry weight) of F_1 adults decreased with increasing dose; however, weights of individuals were not altered. Survival of T. confusum was reduced by 6 kr of x rays and coexistence. (auth)

40547 (NYO-10569) FINAL PROGRESS REPORT [ON TRACE ELEMENTS IN SPLEENS OF IRRADIATED RATS.]. AUGUST 31, 1961–NOVEMBER 1, 1962. (Albany Medical Coll., N. Y.). Contract AT(30-1)-2287. 14p.

The effects of 600-r x radiation and 200 mg/kg of nitrogen mustard on the content of trace elements in the spleen of rats were compared at 4, 8, and 12 days after treatment. Data are presented for Cr, Mo, Mn, Cu, Zn, Fe, P, and N content in normal and treated rats. (C.H.)

40548 (TID-17729) VARIATION IN SIZE, DEVELOPMENT, AND HOOK NUMBER AMONG THE ONCOSPHERES OF NORMAL AND IRRADIATED HYMENOLEPIS DIMINUTA. Arthur W. Jones (Tennessee. Univ., Knoxville). [1962]. Contract AT(40-1)-1749. 3p.

Oncospheres produced by a nonirradiated worm and oncospheres produced by a worm that had been subjected to high γ radiation (successive generations of cysticercoids were irradiated with 15,000 r until a cumulative dose of 120,000 r was obtained) were compared. Radiation had no effect on the sizes of the embryos, the shell, and the median hooks. Radiation may have resulted in certain large, hookless embryos that did not occur in the normal worm. Two anomalies, reduced hook number and failure of growth,

were more frequent in the normal than in the irradiated worm. This result, although surprising, can be explained by the high selection pressure operating under the experimental conditions. (auth)

40549 (TID-18210) THE RELATIVE BIOLOGICAL EFFECTIVENESS OF 22-Mevp X-RAYS, COBALT-60 GAMMA RAYS, AND 200-kvcp X-RAYS. VIII. DETERMINED BY THE GROWTH CAPACITY OF TUMOR CELLS IN VITRO. R. M. Humphrey and W. K. Sinclair (Texas. Univ., Houston. M. D. Anderson Hospital and Tumor Inst.) and Argonne National Lab., Ill.). [1962]. Contract AT(40-1)-2832. 17p.

A determination of the RBE of Co^{60} γ rays and 22-Mevp x rays versus 200-Kvcp x rays was made with growth capacity of Ehrlich ascites tumor cells in vitro as the biological test object. A series of 7 experiments, in which the growth was scored at 4 days after irradiation and compared to the growth of the nonirradiated controls, was conducted. The RBE values were derived from the slopes of the response curves for each individual experiment. The average RBE's are 0.86 for Co^{60} γ rays versus 200-Kvcp x rays; 0.86 for 22-Mevp x rays versus 200-Kvcp x rays, and 1.03 for 22-Mevp x rays versus Co^{60} γ rays. (auth)

40550 (TID-19486) PRODUCTION AND STUDY OF ASPOROGENIC MUTANTS OF BACILLUS CEREUS. Annual Report, December 31, 1962–December 31, 1963. Donald G. Lundgren (Syracuse Univ., N. Y.). Contract AT(30-1)-2038. 77p.

The cultural characteristics of an auxotrophic mutant of Bacillus cereus grown on cyst(e)ine or methione were discussed. Particular attention was given to the accumulation of the polymer, poly-beta-hydroxybutyrate (PHB). The radioresistance of this mutant was compared to the wild type B. cereus where the mutant organism was grown on different S-containing amino acids. A correlation was established in the mutant between the ratio of SS/SH and radioresistance; the higher the ratio the greater the radioresistance. Structural features of PHB granules were studied with electron optics and a carbon replica technique. A membrane was shown surrounding the PHB granules. The membrane was also identified in thin sections of a mutant of B. cereus. Cultural and physical studies of PHB in B. cereus were discussed. The initial phase of our fine-structure study of asporogenic mutants and radioresistant spores has been reported. Electron micrographs are shown relating structural development in both sporulating cells and non-sporulating mutants. (auth)

40551 (TID-19515) RESEARCH ON THE EFFECTS OF RADIATION ON BIOLOGICAL MOLECULES, ON AGGREGATES OF SUCH MOLECULES IN VITRO, AND ON MOLECULES AND AGGREGATES WITHIN CELLS. Progress Report, November 1, 1962–October 31, 1963. Franklin Hutchinson (Yale Univ., New Haven). Contract AT(30-1)-2653. 27p.

Results are reported for studies on the ability of 5-bromodeoxyuridine incorporated in DNA to increase the sensitivity to ultraviolet light and x rays of Diplococcus pneumoniae; the radiosensitivity of DNA transforming activity, the effect of transforming activity of DNA extracted from spores on radioresistance, and the effect of heat shock on spore survival and the transforming of DNA of spores of Bacillus subtilis; the effects of accelerated heavy ions on survival of proliferative capacity, delay of mitosis, and chromosome damage in Chinese hamster cells in tissue culture; and a comparison of the biological efficiency of heavy ions and x rays on survival and mitotic delay in Chinese hamster cells in tissue culture. (C.H.)

40552 STRAHLENINDUZIERTE MUTAGENESE. ERWIN-BAUR-GEDACHTNISVORLESUNGEN II, DEUTSCHEN AKADEMIE DER WISSENSCHAFTEN ZU BERLIN. 6. BIS 10. JUNI 1961. (Radiation Induced Mutagenesis. Erwin-Baur Memorial Lectures II, German Academy of Science, Berlin. June 6 to 10, 1961). H. Stubbe and H. Boehme, eds. Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 1-231(1962).

Twenty-one papers presented at the Erwin-Baur Memorial Lectures II, on Radiation-Induced Mutagenesis at the German Academy of Science at Berlin on June 6 to 10, 1961, are given. Separate abstracts were prepared for each paper. (M.C.G.)

40553 RADIATION-INDUCED MUTAGENESIS—A BIOPHYSICIST'S VIEWPOINT. L. H. Gray (Mount Vernon Hospital, Northwood, Middx., Eng.). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 1-19(1962).

The forms of damage to the genome that may be expressed as mutation range from gross visible re-arrangements down to an unknown lower limit is probably a change in sequence affecting a few nucleotides. Ideas concerning structural re-arrangements induced by x and γ radiation have to take into account the fact that the induction of a simple break in chromosomes of plants and animals is a much rarer event than was formerly supposed and that, as proposed by Revell, most of the breaks seen at a metaphase have arisen in association with the formation of exchanges. Data from which to decide whether breaks seen after exposure to densely ionizing radiation have arisen in association with exchanges or independently is lacking. Alpha radiation is efficient compared with x or γ radiation. Almost every transit of an α particle through a plant nucleus yields an aberration visible at metaphase. Some of the mutations induced in micro-organisms by x rays as well as uv appear to be changes in the genetic material which are strictly reversible. They are invariably initiated by one ionizing particle but may not be due to energy deposition in a single site. Mutations induced by uv frequently increase in proportion to the square of the dose when the organisms are plated on to a rich medium. On other plating media, both those which depress the yield and those which augment it, the mutation frequency was found to rise almost linearly with dose. It is suggested therefore that the two sites of energy deposition indicated by the square law dependence may be concerned with quite different functions. Work has shown that mutations in spermatogonia and oöcytes by x-ray are dose-rate dependent, and also that the induction of somatic mutations in proliferating plant cells is greatly modified by exposure to a dose of 100 rad or less two hours before the test dose. These facts were examined in the light of a number of investigations which show that the ability of a gene to initiate enzyme synthesis is impaired by a dose which is not much greater than that which causes complete loss of reproductive integrity; a dose, moreover, which corresponds to the deposition of energy by a single ionizing particle anywhere in a region which represents an appreciable fraction of the genome. (auth)

40554 RADIATION INDUCED MUTAGENESIS—A BIOCHEMIST'S VIEWPOINT ON SOME ASPECTS OF MUTATION. M. Errera (Université Libre, Brussels). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 20-37 (1962).

It was concluded that many of the effects of radiation

discussed (mutation, chromosome damage) are due to alterations of the DNA molecule. That this could be the result of more complicated mechanisms than those envisaged comes from the following: whereas the biological effects described are strikingly reduced when the pressure of oxygen diminishes (oxygen effect), it was observed in vitro on DNA or bacteriophage, that when irradiated, there is no such dependency of the oxygen pressure and even the effect may be enhanced at lower O_2 pressure DNA seems highly susceptible to indirect effects, but not to the presence of O_2. This led Ephrussi-Taylor and Latarjet to state that x rays do not alter DNA (genetic effects) by immediate action, but that some secondary processes, dependent on O_2 tension do take place before DNA is definitively damaged. What relation there is between these effects and mutation fixation is difficult to assess: the oxygen could increase damage to recovery factors for chromosome breakage; it might also reduce crosslinking in DNA. (auth)

40555 RADIATION-INDUCED MUTAGENESIS—A GENETICIST'S VIEWPOINT. R. Rieger and H. Boehme (German Academy of Sciences, Berlin). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 38-62(1962).

The influence of radiation quality and quantity on the radioinduced mutation processes is discussed. The different sensitivities of various loci of a genotype toward the mutagenic effects of radiation of the same kind and dose were investigated, along with the effects of different kinds of radiation on the same allele. The effects of development stage, growth phase, the presence of oxygen, photoreactivation, and metabolism conditions were also studied. The course of the mutation process was considered. (M.C.G.)

40556 ON THE NATURE OF THE PRINCIPAL TARGET OF LETHAL AND MUTAGENIC RADIATION EFFECTS. W. Szybalski and Z. Lorkiewicz (Univ. of Wisconsin, Madison and Univ. of M. Curie-Sktodowska, Lublin, Poland). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 63-71(1962).

Among the different cell components, DNA appeared to be the most vulnerable to the lethal effects of radiation. This conclusion was based on experiments employing a comparison of the increments in radiation sensitivity of normal and halogenated transforming DNA, on the one hand, and of subcultures of the cells from which the two types of DNA were extracted, on the other hand. The various types of radioinduced damage to the DNA molecules are outlined and their effect on the "priming" and protein synthesis-directing functions of DNA is discussed. With respect to the latter function, the concept of the dominant lethal role of "poisonous-messenger" RNA synthesized under the influence of radiation-damaged DNA is proposed. (auth)

40557 PRIMARY EFFECTS OF ULTRAVIOLET RADIATION ON NUCLEIC ACIDS. D. Shugar (Inst. of Biochemistry and Biophysics, Academy of Sciences, Warsaw and State Inst. of Hygiene, Warsaw). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 72-83(1962).

From investigations on nucleic acid derivatives and related compounds, and on model olizo- and polynucleotides as well as natural nucleic acids, the following appear to be the primary initial effects resulting from irradiation of nucleic acids with uv doses of the order of magnitude producing biological effects (10^2 to 10^6 ergs/mm): purine residues and carbohydrate moieties were unaffected; there was no rupture of internucleotide linkages; for uracil and cytosine residues nucleophilic additions of water may occur across the 5, 6 double bonds; and photochemical reactions between adjacent pairs of uracil and/or thymine rings. Examples of radiation effects are described. (M.C.G.)

40558 RADIOCHEMICAL CHANGES IN NUCLEIC ACIDS IN VIVO AND IN VITRO. A. Wacker (Universität, Frankfurt and Main). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 84-93(1962). (In German)

The radiochemical changes in the basic units of desoxyribonucleic acid (DNA) and ribonucleic acid (RNA) in vivo and in vitro were investigated. The effects of ultraviolet and x radiation were considered. Radiochemical changes in the thymines, photoactivation, electron distributions in thymine dimers, photochemical reactions of uracil and uridine, and radiosensitivity effects of 5-bromouracil were determined. (M.C.G.)

40559 THE PRODUCTION OF ORGANIC PEROXIDES OF VERY HIGH BIOLOGICAL EFFECTIVENESS BY IRRADIATION OF AGAR WITH HIGH DOSES. K. Sommermeyer and H. Magnus (Universität, Freiburg i. B. and Stadtisches Krankenhaus, Karlsruhe, Ger.). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 102-5(1962). (In German)

Irradiation of agars with α particles, ultraviolet radiation, and x rays for the production of organic peroxides was carried out to study the oxygen effect in radiation injuries to Bact. coli cells. (M.C.G.)

40560 ON THE QUESTION OF THE RELEASE OF CHROMOSOME ABERRATIONS BY FREE RADICALS OF WATER IN VICIA FABA SOLUTION. A. Michaelis and R. Rieger (Inst. for Cultivated Plant Research, German Academy of Sciences, Gatersleben, Ger.). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 106-12(1962). (In German)

Vicia faba seeds and main roots were exposed to HO and HO_2 radicals produced with Fenton's reagent ($Fe\,SO_4$ + H_2O_2). The same radicals are induced in the course of radiodecomposition of water with ionizing radiation and the purpose of the experiments was to find out whether these radicals (and H_2O_2) are able to induce chromosome aberrations when chemically produced. In contrast to experiments with barley and Allium chromosome aberrations were not induced within a wide array of experimental conditions. Both the radicals and H_2O_2 proved ineffective in Vicia faba. The results are discussed in connection with their significance for indirect radiation effects via water decomposition products. (auth)

40561 METABOLIC FACTORS CONCERNED IN THE EXPRESSION OF X-RADIATION INDUCED CHANGES IN DNA OF NUCLEATED CELLS. M. G. Ord (Oxford Univ.). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 113-14 (1962). (In German)

A study was begun on the behavior of acid-soluble phosphate compounds in normal thymus nuclei. Both sucrose-$CaCl_2$ and a KCl-rich medium were used. The ATP was firmly bound to the nuclei, whereas about 50% of the inorganic phosphate was in solution. If the nuclei were incubated with P^{32} in vitro a reversible uptake occurred at 0°C that was not temperature sensitive. Extraction of the nuclei with NaCl indicated that the inorganic phosphate was associated with nucleoprotein. Preliminary experiments showed that both ATP and arginine bound to the nucleus can be utilized for incorporation into its acid insoluble fraction. (M.C.G.)

40562 THE EFFECT OF CUPFERRON, CARBON MONOXIDE, AND 2.4-DINITROPHENOL ON THE PRO-

DUCTION OF CHROMOSOMAL ABERRATIONS BY X-RAYS IN VICIA FABA. B. A. Kihlman (Uppsala Univ.). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 131-40(1962).

The effects of cupferron, carbon monoxide, and 2.4-dinitrophenol (DNP) on the frequencies of chromatid aberrations produced by x rays in the root-tips of Vicia faba were studied. At an oxygen concentration of 1% in the gas phase, cupferron and carbon monoxide produced a strong increase in the frequencies of aberrations when they were present before and during irradiation. No enhancement was obtained when the inhibitor treatments were applied immediately after the x-ray irradiation. These results agree with the idea that respiratory inhibitors enhance the x-ray sensitivity of bean roots at low oxygen tensions because they prevent the formation of an oxygen gradient in the roots. In contrast to the cupferron effect, the enhancement produced by carbon monoxide was sensitive to light and occurred only in the dark. At a dose rate of 6.4 r/min. and at an oxygen tension of 100% in the gas phase, both cupferron and DNP enhanced considerably the frequency of chromatid interchanges produced by a given dose of x rays. When the dose rate was increased to 120 r/min., the effect obtained in the absence of the inhibitors increased, whereas that obtained in their presence remained constant. As a consequence, the enhancement produced by the inhibitors at low dose rates disappeared completely (cupferron) or was markedly reduced (DNP) at high dose rates. In contrast to cupferron, DNP did not produce a strong enhancement of the x-ray effect at low oxygen tensions (2% in the gas phase). The enhancement produced by cupferron in the presence of 2% oxygen, was obtained both at low and high dose rates and was equally strong for all types of aberrations. It was concluded that the very strong enhancement of the x-ray effect which cupferron produced at low oxygen tensions is due to its inhibitory effect on respiration. The ineffectiveness of DNP in these experiments indicates that phosphorylation is not involved. The results obtained are in agreement with the idea that cupferron enhances the effect of x rays by eliminating an oxygen gradient, which is supposed to exist in the roots at low oxygen tensions. In contrast to the strong enhancement of the x-ray effect produced by cupferron at low oxygen tensions, the considerably less marked enhancement obtained at high oxygen tensions and low dose rates could be due to the inhibitory action of cupferron on oxidative phosphorylation. The finding that DNP acts in the same way as cupferron in these experiments is in agreement with this interpretation. The effect of cupferron and DNP on x-ray-induced chromosome damage at high oxygen tension appears to be mainly that they cause the dose rate effect to disappear. This is in agreement with the idea that oxidative phosphorylation is needed for the repair of chromosome damage. (auth)

40563 EVIDENCE FOR TWO RESOLVABLE SITES OF ACTION OF RADIATION ON MICROORGANISMS. Tikvah Alper (Hammersmith Hospital, London). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 153-61(1962).

Comparisons were made of the effects of ionizing radiation and ultraviolet light at 2537Å. It is shown how there may be interaction between the radioinduced physicochemical and metabolic methods of modification, and how it may be deduced from these interactions that the observed lethal effect of ionizing radiations, at least on microorganisms, is the summation of events that have taken place in at least two sites, or by at least two distinct modes of action. A model for this concept was set up and applied to Escherichia coli. (M.C.G.)

40564 REVERSIBLE PROCESSES IN THE GENOME OF THE κ PHAGES AFTER UV IRRADIATION OF THE EXTRA-CELLULAR PARTICLES. R. W. Kaplan (Johann-Wolfgang-Goether-Universitat, Frankfurt am Main). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 162-6(1962). (In German)

Indirect causes of mutations in cells can be the incorporation of DNA molecules that were previously damaged by radiation Phages κ from Serratia marcescens were observed for the appearance of mutations after uv irradiation of extracellular particles. (M.C.G.)

40565 INFLUENCE OF COLD OR DRYNESS DURING AS WELL AS TREATMENT WITH BIOCHEMICALS AFTER THE UV IRRADIATION ON THE MUTATION CAUSE FOR SERRATIA. R. W. Kaplan (Johann-Wolfgang-Goethe-Universitat, Frankfurt am Main). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 167-70(1962). (In German)

The effects of water content during irradiation, temperature during irradiation, and treatment with chemicals after irradiation on the radioinduced mutation rate in Serratia marcescens were studied. Effects of radiation decreased with decreasing water content. The uv destruction of the bacteria increased at lower temperatures. Treatment with biochemicals did not show too much effect, but the three mutation groups were very individual in their responses. (M.C.G.)

40566 RADIATION INACTIVATION OF SACCHAROMYCES AND DEPENDENCE ON DEGREE OF PLOIDY AND GENOTYPE. W. Laskowski (Universität, Berlin). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 171-7 (1962). (In German)

A decrease in radiation resistence with degree of ploidy was observed. Dose effect curves were obtained for Saccharomyces strains. (M.C.G.)

40567 UV AND IONIZING IRRADIATION INACTIVATION OF THE STREPTOMYCIN RESISTANCE MARKERS IN TRANSFORMING DNA OF DIFFERENT SPECIES OF BACTERIA. R. Pakula (State Inst. of Hygiene, Warsaw). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 178-87 (1962).

The relative survival of uv-inactivated streptomycin resistance activities in transforming DNA of various bacteria was significantly higher when assayed at low concentrations. The reason for this was inhibition of transformation by uv-inactivated DNA molecules at saturating concentrations used for assay. The extent of uv inactivation of transforming DNA from some bacteria, but not from others, appeared to be lower when assayed in heterospecific than in homospecific transformation reactions. Striking differences were found in energy doses (especially in the terminal parts of the inactivation curves) required to provoke a certain amount of damage in the streptomycin resistance activities of various species of bacteria. Slight but repeatable differences were found in the inactivation for the streptomycin resistance markers in DNA of different bacteria irradiated by gamma rays in aqueous solution. These differences were more distinct when dried preparations of DNA were irradiated and especially when these preparations were protected by yeast extract. Both uv and gamma inactivation suggest that the streptomycin resistance activities of various species of bacteria are under control of different markers. (auth)

40568 ON THE REACTIVATION OF UV-INACTIVATED T1 BACTERIOPHAGES. W. Eckart and W. Eschke (Inst. of Physics and Tech., German Academy of Sciences,

Berlin). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 188-92(1962). (In German)

Photoreactivation of coli phages T1 after ultraviolet inactivation at 254, 280, and 302 nm was studied. The greatest increase in photoreactivation was for the 302-nm-inactivated phages. The wavelength dependence of the multiplicity reactivation was also investigated. Damages to protein at the higher wavelengths and to DNA at the lower ones were postulated. (M.C.G.)

40569 QUANTITATIVE STUDY OF BIOLOGICAL REVERSIONS INDUCED IN THE YEAST SCHIZOSACCHAROMYCES POMBE BY RADIATIONS AND RADIOMIMETIC SUBSTANCES. H. Heslot (Institut National Agronomique, Paris). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 193-228(1962). (In French)

Reversions produced by gamma and uv radiation, peroxides, sodium nitrite, sulfonic and sulfuric esters, β-halogenoethylamines, epoxy compounds, and ethylenimines in Schizosaccharomyces pombe are studied. (T.F.H.)

40570 RADIATION-INDUCED PARAMAGNETIC CENTERS IN PLANT SEEDS AT DIFFERENT OXYGEN CONCENTRATIONS. A. Ehrenberg, L. Ehrenberg, and G. Loefroth (Karolinska Institutet, Stockholm and Universitet, Stockholm). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., No. 1, 229-31(1962).

The possibilities of studying the radiobiologic effects of oxygen by means of electron spin resonance (ESR) spectroscopy are discussed. When seeds of barley or Agrostis stolonifera were irradiated with gamma rays, the number of free radicals measured by means of electron spin resonance, increased linearly with dose up to about 300 krad. When seeds were irradiated in air, a simple narrow absorption line appeared at low doses, but above about 40 krad a superimposed broader signal became more and more evident. When the seeds were irradiated at higher oxygen concentration only signals of the narrow type appeared, the amplitude increasing with dose. (M.C.G.)

40571 MEASURING INSTALLATIONS FOR THE DETERMINATION OF RADIOACTIVITY IN THE HUMAN BODY. A. Pfau (Max-Planck-Institutes fur Tierzucht und Tierernährung, Mariensee, [Ger.]). Atomwirtschaft, 8: 433-41(July-Aug. 1963). (In German)

The question of what is the best available modern measuring installation is discussed. The answer is shown to depend on the chosen criteria. The large-volume installations for measuring radioactivity which were developed may be distinguished in respect of their construction by their mobility, detector arrangements, and detector systems. The specific sphere of application for these installations lies below 10^{-7} c of gamma activity. For comparison of the different systems an analysis was made of the individual requirements such as the smallest error of measurement, the shortest measuring time, the lowest background activity, the highest resolving power for energy, and the costs of purchase and maintenance of the installation. (auth)

40572 UNBALANCED DEOXYRIBONUCLEIC ACID SYNTHESIS: ITS ROLE IN X-RAY-INDUCED BACTERIAL DEATH. Daniel Billen (Univ. of Texas, Houston). Biochim. Biophys. Acta, 72: 608-18(Aug. 20, 1963).

A study was made of the effects of unbalanced DNA synthesis on subsequent cell physiology and x-ray sensitivity of the polyauxotroph, Escherichia coli strain 15T-A-U- (thymine, arginine, and uracil dependent) with the following results: DNA replication, proceeding to completion in the absence of concomitant protein and RNA synthesis, resulted in a cell population with an enhanced DNA content and with increased resistance to the lethal effects of x-ray exposure. This resistance was expressed as an increase in the shoulder of the dose–survival curve and an increase in the mean lethal dose. Renewal of both protein and RNA synthesis after completion of unbalanced DNA synthesis reversed the resistant state. The presence of both arginine and uracil were required for maximum reversal. When only uracil was added, no change in sensitivity was seen. Addition of only arginine resulted in partial resensitization. Incubation of exponential cells in a medium lacking thymine as well as arginine and uracil led to thymine-less death as well as a sensitization to x rays. This was characterized by a shift from sigmoidal to exponential killing. Substitution of 5-bromouracil for thymine during unbalanced DNA synthesis did not interfere with the completion of DNA synthesis. Buoyant density-gradient analysis in CsCl showed that only normal and hybrid DNA were present in such cells. Equilibrium centrifugation of DNA obtained from cells incubated with bromo[C^{14}]-uracil provided confirmation that only hybrid DNA was made during the unbalanced DNA synthesis period. Such cells did not exhibit enhanced resistance to x rays, but to the contrary were more sensitive than the control population. (auth)

40573 RADIOSENSITIVITY OF GLYCOLYTIC ENZYMES IN THE NUCLEUS. Ulrich Hagen, Hanna Ernst, and Ingrid Cepicka (Universität, Freiburg i. B. and Heiligenberg-Institutes, Baden, Ger.). Biochim. Biophys. Acta, 74: 598-607(Sept. 10, 1963). (In English)

Thymus nuclei of mice and rats were isolated during the first 12 hr following 800 r whole-body irradiation and extracted with 0.14 M NaCl. In the extracts total protein, lactate dehydrogenase, glyceraldehyde-3-phosphate dehydrogenase, and aldolase were assayed. Within the first 2 hr after irradiation, there was a decrease in the enzymic activity of lactate dehydrogenase and glyceraldehyde-3-phosphate dehydrogenase down to 50 to 70% of the controls; simultaneously, there was a depletion of protein. After a short recovery period, the activities of lactate dehydrogenase and of aldolase decrease slightly to 50% of the activities of their controls 12 hr after irradiation. The nuclear glyceraldehyde-3-phosphate dehydrogenase, however, is completely inactivated 8 hr after irradiation, whereas in the cytoplasm this enzyme is unaffected. Studies on the supernatants obtained in the course of isolating the nuclei, and assays on nuclei isolated in non-aqueous media, suggest that the enzymes are released from the nucleus into the cytoplasm in an early post-irradiation period, as a result of damage to the nuclear membrane. The glyceraldehyde-3-phosphate dehydrogenase is completely destroyed in the nucleus simultaneously with the death of the cell. (auth)

40574 A ROLE OF HOST BACTERIA IN INDUCIBILITY OF COLICIN I PRODUCTION BY ULTRAVIOLET LIGHT. P. Amati (Massachusetts Inst. of Tech., Cambridge). Biochim. Biophys. Acta, 74: 783-4(Sept. 10, 1963). (In English)

Colicinogenic factors were reintroduced into various strains derived from Escherichia coli K12. E. coli strains carrying colicinogenic factor I proved to be inducible to colicin production by uv irradiation. Experiments on E. coli K12 and Salmonella typhimurium led to the conclusion that the state of a colicinogenic factor in a bacterium is controlled by the genotypes of both the host and the factor. (C.H.)

40575 ON THE MECHANISM OF ULTRAVIOLET-INDUCED MUTATIONS. Alberte Pullman and Bernard Pullman (Université, Paris). Biochim. Biophys. Acta, 75: 269-71(Sept. 24, 1963).

Calculations based on the Hückel molecular-orbital method were made of excited states induced by ultraviolet radiation for the purine and pyrimidine bases of DNA. Data are presented for uracil, thymine, guanine, cytosine, and adenine. It is postulated that the ease of tautomeric transformations of these compounds in their excited states may account in part for the enhancing effect of ultraviolet radiation on the rate of mutagenesis. (C.H.)

40576 THE SERUM GLYCOPROTEIN RESPONSE FOLLOWING X-IRRADIATION AND PRIMARY IMMUNIZATION IN THE RABBIT. Henry E. Weimer, Marvin B. Rittenberg, and Eric L. Nelson (Univ. of California, Los Angeles). Can. J. Biochem. Physiol., 41: 2147-56(Oct. 1963).

Serial determinations of total serum glycoprotein, seromucoid hexose, total serum protein, and antibody levels were carried out in four groups of adult, male albino rabbits subjected to: 400 r whole body x irradiation; immunization with 10 mg I^{131} BSA; irradiation followed by antigen injection 24 hours later; and bleeding controls. The radiation dose employed suppressed the antibody response of the third procedure. Significant increases in total glycoprotein and seromucoid hexose occurred 24 hours after exposure in the irradiated groups and persisted for 4 days. Pronounced decreases in total protein were observed in all but the last procedure. It was concluded that increases in serum glycoproteins were related primarily to tissue injury. (auth)

40577 AEROBIC GLYCOLYSIS OF X-IRRADIATED THYMOCYTES. Kimiko Araki and D. K. Myers (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Biochem. Physiol., 41: 2157-69(Oct. 1963).

The aerobic lactate production of rat thymocyte suspensions incubated at 37°C for 2 hours was doubled following exposure to approximately 70 r x radiation. Lower doses down to 18 r also produced a significant increase in aerobic lactate production. Increased lactate accumulation following exposure to 1000 r was observed after incubation for as little as 30-60 minutes, though the rate of accumulation increased still further between 2 and 4 hours incubation. A decrease in pH or temperature during incubation of irradiated thymocyte suspensions minimized the lactic acid accumulation. A comparison of the effects of x irradiation in different media and of the effects of several metabolic inhibitors suggested that the increase in aerobic lactate production was a sensitive indicator of cell damage associated with the loss of intracellular potassium ions. Respiration and anaerobic glycolysis of the thymus cells were both much less sensitive than aerobic glycolysis to the effects of x irradiation. The anaerobic lactate production of rat thymocyte suspensions in the presence of dinitrophenol was reduced by 50% after exposure to 5000-6000 r of x radiation. (auth)

40578 BEHAVIOR OF THE SAHARAN SCORPION ANDROCTONUS AMOREUXI (AUD. AND SAV.) AFTER EXPOSURE TO HIGH DOSES OF γ RADIATION AND AILMENTS FOLLOWING THIS IRRADIATION. Pierre Niaussat, Max Vachon, Claude Grenot, and Franklin Pierre (Laboratoire d'Études sur les Arthropodes Irradiés, Paris). Compt. Rend., 257: 1177-80(July 29, 1963). (In French)

The relatively long evolution of radiation sickness in the scorpion Androctonus amoreuxi, after exposure to high γ doses of 50,000 to 90,000 r confirms the high radioresistivity of this species. Behavior modifications because of shock to sensory and neuromotive centers, an acceleration of the cardiovascular rhythm, and a decrease of the body weight were established. (tr-auth)

40579 CONCERNING THE RADIOSENSITIVITY OF THE SPERMATOGONIA. S. Atsev. Compt. Rend. Acad. Bulgare Sci., 16: 301-4(1963).

Quantitative changes occurring in the course of spermatogenesis as affected by x and gamma rays were investigated. The rays proved not to destroy the spermatogonia or the special varieties of cells associated with spermatogenesis. With a dose of 1473 roentgens, for example, the mitotic activity of the spermatogonia increased by a factor of more than 8 between the second and seventh hours after treatment, that of the spermatocytes of the first order by a factor of $3\frac{1}{2}$, and that of the spermatocytes of the second order by a factor of 2. While the biological activity increased in terms of the cells, the biological function was depressed and disappeared in terms of the organs and of the organism. It is speculated that the equilibrium and unity of the functions of the cells and those of the organs and the organism as a whole were destroyed. (OTS)

40580 THE EFFECT OF IONIZING RADIATIONS ON THE CARDIAC MUSCLE OF MAMMALS. T. V. Tarapina (Pavlov Medical Inst., Ryazan, USSR). Dokl. Akad. Nauk SSSR, 152: 202-4(Sept. 1, 1963). (In Russian)

A total of 200 white rats was exposed to whole-body x-irradiation (600 r) and then sacrificed at different times (6 hr to 8 months after the irradiation). The hearts were examined for initial (reactive), and distrophic alterations of the cardiac muscle such as fragmentation, granular decomposition, fatty degeneration and variations in the glycogen level. During the first two days after irradiation, no alterations are found in the myocardium. They begin to appear after 4 to 5 days and become serious at the 8th day. Swelling and disjunction ("combing") of the myofibrils took place, accompanied by decomposition of the nuceli. Eventually, myofibrils underwent vacuolization and granular decomposition, while the subepicardial layer became infiltrated with blood. The glycogen content of the cardiac muscle was only slightly affected by the sugar content on the blood and in the food; myocardium, however, was more sensitive to a loss of glycogen than liver or skeletal muscles. No change in the glycogen content of the heart was detectable during the first post-irradiation period; 5 to 7 days after irradiation, however, a marked decrease in glycogen is observed. At this stage, glycogen was found accumulated in droplets and irregular masses within the cells. This decrease was still present 2 to 3 months after the irradiation, although there was a tendency toward an increase to normal glycogen values. The cardiac muscle was concluded not to be a morphologically radioresistant structure; and, therefore, it undergoes both reactive and destructive alterations upon irradiation with x rays. (TTT)

40581 RADIATION IN ECOLOGY. Manuel Nieto Garcia (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 7: No. 26, 27-41(Apr.-June 1963). (In Spanish)

The effects of radiation on an ecological system are reviewed. The radiation sources and the ecological system are first defined. The trophic structure of this system is briefly described, and the ecological pyramid is discussed. The chemical composition of the ecological system and uptake mechanisms are given. The existence of thermal variations and their effects on the ecology are discussed. The

response of the ecological system to radioactive contamination is considered. 23 references. (J.S.R.)

40582 SOME CHANGES IN THE CYTOPLASM OF LIVER CELLS AFTER X-RAY IRRADIATION. ELECTRON MICROSCOPY STUDY. I. Hradil (Charles Univ., Hradec Králové, Czech.). Folia Biol. (Prague), 9: 287-91(1963). (In English)

The effect of x irradiation with a dose of 2,000 r on the organelles of the liver cells of healthy white rats (Wistar) was studied. The animals were killed one, 25, 50, and 73 hours after irradiation. Electron microscopy showed that the most marked changes appeared about 50 hours after irradiation. At this stage a decrease occurred in the number of mitochondria, which merged, formed clumps and migrated from the nucleus towards the cell periphery. The ergastoplasmic reticulum decreased and marked vacuolation of the cytoplasm occurred. Later (about 73 hours after irradiation) conditions returned to normal. (auth)

40583 EFFECT OF A RAISED OXYGEN CONCENTRATION IN AIR INHALED DURING IRRADIATION ON THE SURVIVAL OF IRRADIATED MICE AND THE PROTECTIVE EFFECT OF CYSTEINE. A. Vacek and Eva Davidová (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 9: 292-7(1963). (In English)

The effect of a raised oxygen concentration in inhaled air on mortality among mice irradiated with a dose of $LD_{50/30}$ and $LD_{100/30}$ was studied. No difference was found in mortality among animals irradiated in air (21% O_2) or in a pure (100%) oxygen atmosphere. Mortality among animals irradiated in a mixture of 95% O_2 and 5% CO_2, however, was 92%. Oxygen tension in the brain, intestine, liver, spleen, and muscle rose during the inhalation of oxygen and remained high during the whole time of administration of O_2. It is assumed that the increase in mortality on inhalation of 95% O_2 + 5% CO_2 is due to a change in the diffusion of oxygen into the cells. The intraperitoneal administration of cysteine in a dose of 900 mg/kg seven minutes before irradiation protected all animals irradiated with a dose of $LD_{100/30}$ and in irradiation 20 minutes after injection 50% of the animals were protected. The inhalation of pure oxygen after the injection of cysteine, either before or during irradiation, inhibited the protective effect of the cysteine. It is assumed that the decrease in the protective effect of cysteine is due to its oxidation by the raised amount of oxygen in the tissues. (auth)

40584 PREDICTION OF INDIVIDUAL DIFFERENCES IN POSTIRRADIATION REGENERATION OF THE LYMPHATIC TISSUE OF THE THYMUS. M. Pospisil (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 9: 299-304(1963). (In English)

Individual variations in the excretion of sodium and potassium in the urine (the Na/K ratio of mice starved for 24 hours and kept in metabolic cages) was found to be a suitable criterion for evaluating the degree of regeneration of the lymphatic tissue of the thymus, which was studied on the seventh and tenth day after irradiation with a single whole body dose of 100 r. Comparison of the two sets of values was based on the difference in the Na/K ratio 24 hours before killing the experimental animals and the values determined 24 hours before irradiation. The rate of regeneration of the lymphatic tissue of the thymus was higher in animals in which this difference was low and high. Changes in the Na/K ratio after irradiation as compared with the initial pre-irradiation values are regarded as the quantitative expression of the efforts of the organism to maintain homoeostasis. A low and high degree of mobility of this parameter is thus accompanied by higher regenerative capacity of the lymphatic tissue of the irradiated organism. The methodological significance of this finding for the interindividual differentiation of the reaction of experimental animals to irradiation is emphasized. (auth)

40585 INDEPENDENCE OF THE INCREASE IN VOLUME OF X-IRRADIATED HeLa CELLS ON RADIATION DOSES. M. Klimek and Miluse Vlasinová (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 9: 314-18(1963). (In English)

Cells of the wild HeLa strain were cultured and given 1200 to 3000 r doses of x rays. At intervals following irradiation of the 48 hour-old cultures (i.e. 2, 4, 6, 8, 10, 11, 12 days) three flasks were taken from each experimental batch. Cells, obtained in approximately spherical shape, were measured by means of a micrometer. Results clearly demonstrated that cell volume increase after irradiation, during the process of giant cell formation, is not dose dependent. Thus it is indicated that biosynthetic processes are not sensitive to irradiation. Consequently, giant cell formation is evidently the result of damage to the genetic apparatus of cells or to the mechanism necessary for cell division. Results are discussed with respect to the literature on giant cells. (H.M.G.)

40586 INEFFECTIVENESS OF LIPOTROPIC SUBSTANCES IN POSTIRRADIATION FATTY INFILTRATION OF THE LIVER. M. Skalka (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 9: 319-21(1963). (In English)

The possibility of a disturbance by irradiation of the metabolism of lipotropic substances, especially chloine and methionine, which results in fatty infiltration of the liver was investigated. Adult strain H mice were fed on a standard Larsen diet with water ad lib. Choline hydrochloride was administered intraperitoneally in amounts of 1 mg in 0.1 ml saline per mouse daily starting on the sixth day. L-methionine was administered by the same route in amounts of 5 mg/10 g on the third, fifth, seventh, ninth, and eleventh days postirradiation. The Soviet Preparation Lipokain was used as the lipocaic pancreatic factor. The animals were given 620 and 630 r doses of x radiation. It was found that administration of the lipotropic substances choline, methionine, and lipocaic did not influence fatty infiltration of the liver that occurs in mice subjected to whole-body irradiation with a large dose of x rays during the bone marrow syndrome. (H.M.G.)

40587 EFFECT OF 2-AMINO-2-HYDROXYMETHYL-1,3-PROPANEDIOL (TRIS) ON THE INACTIVATION OF GREEN GRAM (PHASEOLUS AUREUS) 3′-NUCLEOTIDASE BY X-RAYS. Ranjeeth K. Ahluwalia and R. K. Maller (Indian Inst. of Science, Bangalore). Indian J. Exptl. Biol., 1: 156-7(July 1963).

In vitro experiments showed tris to be an effective protector of green gram (Phaseolus aureus) 3′-nucleotidase against x-ray inactivation, the protection afforded being almost equal to that by β-mercaptoethylamine. A similar effect against the action of chemically produced free radicals on the enzyme was not observed. (auth)

40588 ULTRAVIOLET-X-RAY INTERACTION IN RELATION TO FREQUENCY AND TYPES OF CHROMOSOME ABERRATIONS AND MUTATIONS IN TRITICUM AESTIVUM L. Satya Nirula (Indian Agricultural Research Inst., New Delhi). Indian J. Exptl. Biol., 1: 210-14(Oct. 1963).

The effects of subjecting dry seeds of bread wheat to combined and separate treatments of ultraviolet and x rays

on the frequency of chromosome aberrations, and the rate and spectrum of mutations were studied. Somatic chromosome aberration frequency was found to increase with dose in x-ray treatments. Pre-treatment with ultraviolet promotes reunion and thereby increases the frequency of two-hit aberrations and the total aberration rate. At meiosis in microsporocytes, a corresponding increase in translocation frequency is observed in ultraviolet pre-treated plants. The rate of viable morphological mutations increases with the x-ray dose. When pre-treated with ultraviolet, the mutation rate is reduced at 11000, 16500, and 33000 r of x rays but is enhanced at 22000 r. Mutations affecting ear characters constitute 92% of the total number of mutations isolated in ultraviolet pre-treated material, while this frequency is about 84% following x-ray treatment. Thus, in spite of its poor penetrating ability, it appears that ultraviolet irradiation can be effectively used for irradiating seeds of wheat, the caryopsis of which allows direct exposure of the embryo. (auth)

40589 RADIATION CANCER OF THE SKIN (A CASE REPORT). A. D. Singh and I. B. Scudder (Christian Medical Coll. Hospital, Vellore, India). Indian J. Radiol., 16: 41-4(Feb. 1962).

The history is presented of a patient who developed epithelioma of the irradiated skin 20 yr after x-ray treatment for lympho-epithelioma of the tonsil. (C.H.)

40590 A STUDY OF POSTIRRADIATION CHONDROSARCOMA OF BONE. Vatasala V. Vakil and M. V. Sirsat (Tata Memorial Hospital, Bombay). Indian J. Radiol., 16: 239-42(Nov. 1962).

The history is presented of a case of chondrosarcoma that developed 6 yr after therapeutic irradiation of a Ewing's sarcoma at the same site. An attempt is made to trace the evolution of post-irradiation chondrosarcoma of the bone. (C.H.)

40591 BETA HISTORADIOGRAPHY WITH TRITIUM. F. Barreira, A. Brito Carvalho, and J. M. Vidal Sobral (Estudos de Energia Nuclear I.A.C., Lisbon). Intern. J. Appl. Radiation Isotopes, 14: 428-9(Sept. 1963). (In English)

Tritium was found to be useful in the radiography of histological preparations. The radiographs disclosed a very fine reticular structure that cannot be seen in the colored preparations. (P.C.H.)

40592 THE DEVELOPMENT OF THE CONCEPT OF X-RAY DOSAGE. Gyula Koczkas. Magy. Radiol., 15: 215-21(Aug. 1963).

Two concepts of dosage are defined. It is believed that the value often called ion dose should simply be termed dose, and the concept of the absorbed dose should be termed as energy dose. Also, the units used should be termed r and rad, respectively. This would lend clear and uniform concepts to dosimetry and would be useful in radiology. (OTS)

40593 THE EFFECT OF X-RAY AND ULTRAVIOLET IRRADIATION ON THE GEMMATION OF YEAST CELLS TREATED IN THE LATENT PHASE. Tibor Ganti and J. Nagy. Magy. Radiol., 15: 239-46(Aug. 1963).

Changes occurring in Saccharomyces cerevisiae at the first gemmation were examined. Irradiation was performed at different times of the lag phase. Under the effect of uv radiation, the degree of synchronism and the number of the cells able to multiply decreased. This effect, however, was not observed if the irradiation was done before the beginning of the gemmation. In the case of x irradiation, only a displacement on the time curve of the gemmation was observed. A well defined time period is necessary for the manifestation of this. (OTS)

40594 THE DOSE-TIME DISTRIBUTION FACTOR IN EXTERNAL AND INTERNAL IRRADIATION FROM THE CLINICAL AND EXPERIMENTAL POINT OF VIEW. F. Bistolfi, N. Macarini, and L. Oliva (Università, Genoa). Minerva Nucl., 7: 215-35(June 1963). (In Italian)

The statistical nature of the interaction between radiations and matter is, together with the hit theory, taken as the basis for an analysis of its relations with the time factor. The concepts of VET, VET/min., and limit or critical intensity are defined and an examination is made of the relations between LET (linear energy transfer) and selective action and between RBE (relative biological effectiveness) and time dose distribution. A critical analysis is made of ultrafractionation and moving beam therapy, with particular reference to the general value of the concept of isochronotopy (time-space concept). The concepts of recovery in continuous and fractionated irradiation, residual dose, cumulative dose, and half and average recovery time (D_r 50 and 37% respectively) are defined and mention made of their applications in external and internal radioisotope therapy. A review of the experimental literature on the subject is based on three types of experiments: high- and low-intensity continuous radiation; fractionated radiation over variable and constant periods. Particular emphasis is laid on the concepts of critical interval and moment of maximum vulnerability reaction, which form the bases of cyclic biological irradiation. The aspects of the time factor with regard to high-energy therapy and radioisotope therapy are discussed from a radiotherapeutic standpoint, and an account is given of the clinical applications of cyclic biological irradiation. Reference is made to the practical importance of isoeffectiveness curves from a clinical and general radiobiological standpoint. (auth)

40595 THE RETICULO-ENDOTHELIAL FUNCTION IN ANIMALS EXPOSED TO IONIZING RADIATION, STUDIED WITH THE HELP OF Au^{198} IN COLLOIDAL SUSPENSION. G. Gasso, A. Billitteri, and S. Romeo (Università, Catania, Italy). Minerva Nucl., 7: 251-2 (June 1963). (In Italian)

The function of the reticulo-endothelial system was investigated by determining the granulopectic index following the intravenous injection of colloidal Au^{198} in rabbits after total irradiation with a single lethal dose of 1000 roentgen units, 11 hours and 5 days after irradiation. The granulopectic index was considerably decreased in the irradiated animals as compared with the controls. The slight difference observed between the two groups of irradiated animals was not significant. (auth)

40596 ACTION OF IONIZING RADIATIONS ON INORGANIC PYROPHOSPHATASE IN MOUSE BRAIN AND LIVER. L. Ababei, S. Capalna, E. Ghizari, P. Stefanescu, S. Schiau, and R. Stoenescu (Inst. of Normal and Pathological Physiology, Bucharest). Naturwissenschaften, 50: 549-50(1963).

The variation of inorganic pyrophosphatase activity occurring in mouse brain and liver tissues after whole-body x irradiation (500 r) lasting 58 min. was studied. No change of liver activity was noted after 2 hrs, but 24 and 48 hrs after irradiation the enzyme activity was reduced by 25 and 50%, respectively. No effect was observed in the brain tissues for the first 24 hrs, but after 48 hrs the enzyme activity was significantly inhibited. (J.S.R.)

40597 THE EFFECT OF AMINOETHYLISOTHIOUREA (AET) ON THE RADIO-INDUCED MUTATION RATE IN E. COLI. H. A. Kuenkel and H. Rodegra (Strahlenbiologisches Institut und Universitatsklinik fur Hals-, Nasen- und Ohrenkrankheiten, Hamburg). Naturwissenschaften, 50: 594(1963). (In German)

Aminoethylisothiourea was added to E. coli suspension 15 min. before irradiation with doses of 40,000 and 80,000 r. The effects of AET on the inactivation and the rate of the radioinduced back mutation to prototropy were determined. The results show a significant radioprotective effect of AET. The mutation rate, however, was increased by the application of AET before the irradiation. An interpretation of this amplification of the mutation rate is not available at the present. (J.S.R.)

40598 FUNCTIONAL MODIFICATION OF BLADDER IRRADIATION (CISTOMENOMETRIC RESEARCH). G. Muzii (Università, Rome). Nuntius Radiol., 29: 303-11 (Apr. 1963). (In Italian)

Results of the cystomanometric method employed to study the functional changes of the urinary bladder in patients irradiated for uterus neoplasms are reported. In the cases irradiated by either betatron or telecobalt-therapy an increased tonometric index was found, as expression of the decreased capacity of adaptation of the urinary bladder wall to the increased content. This change proved to be proportional to the dose. (auth)

40599 STUDIES ON THE CELL-FREE TRANSMISSION OF X-RAY AND 20-METHYLCHOLANTHRENE-INDUCED RF MOUSE LEUKEMIA. Shozo Irino, Zensuke Ota, Koichi Okada, et al. (Okayama Univ., Japan). Okayama Igakkai Zasshi, 75: 213-31(Mar. 1963). (In Japanese)

The incidence of leukemia in RF mice exposed to a single whole-body irradiation of 350 r x-rays was 77.4%, in 41 out of 53 animals. In all, 20 developed the thymic and 20 the non-thymic lymphocytic leukemia, while only one developed myelogenous leukemia. The incidence of leukemia by 20-methylcholanthrene painting was 88% in 22 out of 25 animals. Of them, 12 developed lymphocytic leukemia and 10 myelogenous leukemia. Cell-free filtrates from the leukemic mice, which were induced by a single whole-body x irradiation, were inoculated to the newborn mice of the same strain less than 16 hours old. Two (16.7%) of the twelve inoculated animals developed leukemia on the 357th and 374th days, respectively, after the inoculation. Attempts to inoculate cell-free filtrate from 20-methylcholanthrene-induced leukemic RF mice to newborn mice of the same strain were successful. Cell-free filtrate from the myelogenous leukemic mouse caused lymphocytic leukemia in one of three inoculated mice. This is suggestive of the possibility of transformation of the type of leukemia during cell-free transmission. Virus-like particles were demonstrated by electron microscope in the lymph nodes of 20-methylcholanthrene-induced leukemic mice. The results suggest that x-ray and chemical carcinogens may act to induce leukemia or mammary carcinoma by the activation of a latent virus naturally resident in the RF mouse. (P.C.H.)

40600 THE EFFECT OF ACRIFLAVINE ON PHOTOREVERSAL OF LETHAL AND MUTAGENIC DAMAGE PRODUCED IN BACTERIA BY ULTRAVIOLET LIGHT. Evelyn M. Witkin (State Univ. of New York, Brooklyn). Proc. Natl. Acad. Sci. U. S., 50: 425-30(Sept. 15, 1963).

The addition of acriflavine to the postirradiation plating medium has the following effects in strain WU36, a tyrosine-requiring substrain of E. coli B/r: it enhances both the lethal and mutagenic effects of uv, decreasing survival and increasing the yield of tyr+ mutations; it reduces the efficiency of photoreversal of induced prototrophs, increasing the amount of light required to accomplish maximal photoreversal about fourfold, while having no such effect on the photoreversal of uv killing; it reduces the efficiency of photoprotection against induced prototrophy, while having no such effect on photoprotection against uv killing. Mutations to prototrophy are reducible in frequency by pretreatment with visible light to the same extent as by posttreatment with visible light, although maximal photoprotection requires about four times as much light as maximal photoreversal. In contrast, very little photoprotection against uv killing is obtained in this strain. The results are interpreted as evidence that the lesions leading to photoreversible uv killing and those leading to photoreversible uv-induced prototrophy are different, either in their primary nature or in some unknown secondary feature. (auth)

40601 ON RELATIVE VIABILITY AND REPLACEMENT. Bruce Wallace (Cornell Univ., Ithaca, N. Y.). Proc. Natl. Acad. Sci., U. S., 50: 514-24(Sept. 15, 1963).

A type of replacement exists that could seriously alter the outcome of studies on the viability of irradiated x chromosomes. Conditions under which the replacement could occur were defined, and a search was made for this kind of replacement by comparing the number of Drosophila melanogaster of various genotypes emerging in comparable lethal and nonlethal cultures. Approximately 5,000 control and irradiated x-chromosomes were tested. Levels of radiation used were 500, 1000, and 2000 r of x rays. A total of 77 lethals were recovered among irradiated cultures, for which 77 nonlethals were chosen for comparative analysis. It was found that heterozygous females carrying an irradiated chromosome do not possess a unique replacement ability. Lethal heterozygotes have somewhat impaired viabilities, but there is no evidence in this data that replacement of the sort that causes spurious ratios occurs in the tests involving the x-chromosome. Evaluations are made of suggestions on experimental data interpretations. (H.M.G.)

40602 DISTURBANCES OF NUCLEIC ACID METABOLISM PRECEDING DELAYED RADIONECROSIS OF NERVOUS TISSUE. Wolfgang Zeman (Indiana Univ., Indianapolis and Brookhaven National Lab., Upton, N. Y.). Proc. Natl. Acad. Sci. U. S., 50: 626-30(Oct. 15, 1963). (BNL-7222)

An almost fiftyfold increase in the mitotic index of the interstitial elements of the irradiated murine spinal cord was encountered between four and five months following x radiation exposure to 3500 rads, a dose leading to delayed necrosis after 166-227 days. There was a concomitant, yet statistically not significant, increase in the uptake of RNA precursors, also antedating the manifestation of delayed necrosis. The findings are considered to be the possible result of chromosomal radiogenic injury or of a genetic injury to the RNA synthesizing cellular systems. (P.C.H.)

40603 THE EFFECTS OF ULTRAVIOLET-IRRADIATED POLYURIDYLIC ACID IN CELL-FREE PROTEIN SYNTHESIS IN ESCHERICHIA COLI. II. THE INFLUENCE OF SPECIFIC PHOTOPRODUCTS. Lawrence Grossman (Brandeis Univ., Waltham, Mass.). Proc. Natl. Acad. Sci. U. S., 50: 657-64(Oct. 15, 1963).

Two uracil photoproducts are formed when polyuridylic acid (poly U) is irradiated with ultraviolet light. A molecule of water may add at the 4,-5 double bond of the uracil moieties as a result of irradiation and these may be reconverted to uracil by base-catalyzed dehydration. The other photo-

product formed is a uracil-uracil dimer, which reverts to uracil by reirradiation at lower wavelengths of ultraviolet light. The effects of irradiated poly U were studied in the amino acid incorporating system in which dehydration and photoreversal of the irradiated poly U separated some of the ultraviolet effects. It was concluded that the water adduct is responsible for the coding transition of C^{14}-phenylalanine to C^{14}-serine, and the formation of dimer results in the loss of the incorporation of C^{14}-phenylalanine, which is not replaced by any other amino acid. (P.C.H.)

40604 UV-INDUCED ELECTRON SPIN RESONANCES IN DNA AND THYMINE. J. Eisinger and R. G. Shulman (Bell Telephone Labs., Murray Hill, N. J.). Proc. Natl. Acad. Sci. U. S., 50: 694-6(Oct. 15, 1963).

The electron spin resonance absorption spectra of uv irradiated DNA and thymine was observed. The principal free radical formed in both cases as determined by analysis of the resonance data, consisted of an unpaired electron on the 5-carbon of thymine. (P.C.H.)

40605 EFFECT OF IN VIVO X-IRRADIATION ON NUCLEOPROTEIN STABILITY. R. D. Bauer (Long Beach State Coll., Calif.), K. Dreher, and N. B. Kurnick. Radiation Res., 20: 24-9(Sept. 1963).

The deoxyribonucleoprotein and DNA isolated from radiosensitive tissues (thymus and spleen) of rats 24 hr after lethal whole-body irradiation were found to show changes in solubility in salt solutions of various ionic strengths. Changes in ease of deproteinization by detergent were also observed. No marked changes in these characteristics were noted in the DNP prepared from the radioresistant organs (liver and kidney) studied. These studies do not indicate whether these effects are autolytic or direct, however. (auth)

40606 LONG-TERM PATHOLOGIC AND BEHAVIORAL CHANGES IN MICE AFTER FOCAL DEUTERON IRRADIATION OF THE BRAIN. J. M. Ordy, T. Samorajski, W. Zeman, R. L. Collins, and H. J. Curtis (Cleveland Psychiatric Inst., Cleveland; Indiana Univ., Indianapolis; and Brookhaven National Lab., Upton, N. Y.). Radiation Res., 20: 30-42(Sept. 1963).

Tissue sections were prepared from mice that received an entry dose of 8000 rads with 1.0-mm deuteron beams and from mice that received 72,000 rads with 0.025-mm slit microbeams, directed to discrete regions of the brain. The earliest histologic changes at 7 days postirradiation with 1.0-mm beams were confined to the end of the beam track (Bragg zone) and consisted of some early cell pyknosis and vascular congestion associated with either swollen or pyknotic endothelial nuclei. At 7 months after irradiation, these radiogenic lesions were characterized by substantial enlargement resulting from the disappearance of additional nerve-cell bodies at the Bragg zone leaving only fluid-filled cavities without structural detail. The time course of the histopathologic change produced by 0.025-mm microbeams involved early selective nerve cell necrosis at 7 days postirradiation without evidence of vascular damage. Major delayed changes in the radiogenic lesions with time were not observed after microbeam irradiation. Fifty irradiated mice, including 10 sham-irradiated controls, were tested for long-term behavioral effects on open-field exploration, spontaneous locomotor activity in activity wheels, and stress reactivity under shock-elicited escape-avoidance conditioning. Beginning with the second month after irradiation, small but statistically significant differences were observed in some irradiated groups. Group differences in test performance included changes in relation to the behavior of the control group as well as among some irradiated groups. The irradiated group exposed to 1.0-mm deuteron beams at 8000 rads directed to the cerebellum was most clearly and consistently deviant on locomotor activity wheels and escape-avoidance conditioning. Other group differences in behavior were interpreted in terms of differences in beam size and geometry, dose level, and location of the radiogenic lesions. (auth)

40607 THE RECOVERY OF VICIA FABA MERISTEM CELLS FROM X-RADIATION. Eric J. Hall (Churchill Hospital, Oxford) and Laszlo G. Lajtha. Radiation Res., 20: 187-94(Oct. 1963)

With the roots of Vicia faba seedlings used as a test system, the effect of two doses of x rays separated by a variable time interval is described. The results are used to infer the rate of recovery of radiation damage in Vicia meristem cells, a rate shown to vary with the temperature at which the roots are stored between doses. (auth)

40608 DOSE-RESPONSE RELATIONSHIP FOR REPRODUCTIVE INTEGRITY OF VICIA FABA DEDUCED FROM PROTRACTED IRRADIATION EXPERIMENTS. Eric J. Hall (Churchill Hospital, Oxford). Radiation Res., 20: 195-202(Oct. 1963).

The daily growth rate of bean roots was observed for several weeks under continuous irradiation at low dose rates. A method was developed to deduce from this data the dose-response curve for reproductive integrity of the meristem cells due to protracted irradiation, by assuming the relationship to be an exponential function of dose. (auth)

40609 EFFECT OF MODERATE DEGREES OF HYPOTHERMIA ON THE SENSITIVITY TO WHOLE-BODY IRRADIATION IN ADULT RATS. Donald J. Pizzarello, Daniel Isaak, Richard L. Witcofski, and E. Ann Lyons (Bowman Gray School of Medicine, Winston-Salem, N. C.). Radiation Res., 20: 203-6(Oct. 1963).

Adult female CFN[3] rats were cooled to a body temperature of 25°C by immersion in a water bath. The animals were maintained in a hypothermic state for eight hours before irradiation. A lethal dose of 900 r of x radiation was administered at room temperature after which body temperature was gradually returned to normal. All animals that were hypothermic when irradiated survived at least five months, whereas those not hypothermic when irradiated were all dead within 13 days. Animals subjected to hypothermia alone showed no ill effects. Possible mechanisms of hypothermic protection are discussed. (H.M.G.)

40610 THE EFFECTS OF PREIRRADIATION AND POSTIRRADIATION TEMPERATURE TREATMENTS ON THE X-RAY SENSITIVITY OF SEEDS OF HORDEUM. Victoria L. Bergbusch and Richard S. Caldecott (Univ. of Minnesota, St. Paul). Radiation Res., 20: 207-20(Oct. 1963).

Dry (approximately 4% water content) seeds of Himalaya barley, when heated prior to irradiation, underwent little or no storage injury; also, the increase in injury due to aerobic hydration was as great 48 hours after irradiation as it was immediately thereafter. The effectiveness of preirradiation heat-treatments in reducing seedling injury depended on both the length of the heat-treatment and the temperature; it had no effect if hydration intervened between heating and irradiation. Postirradiation storage of seeds at elevated temperatures (75°C) caused an increase in injury over short storage periods but brought about a thermorecovery over longer storage periods. Preliminary experiments with acute postirradiation heat-treatments

indicated that they, like preirradiation heat-treatments, decreased the amount of injury throughout the storage period. Irradiated seeds stored at dry ice temperature (–78°C) showed virtually no increase in injury over long storage periods, and, as with preirradiation heat-treated seeds, they retained their sensitivity to aerobic hydration. The effects of preirradiation heat-treatment and postirradiation storage over a wide range of temperatures on the response of irradiated seeds to storage and to aerobic hydration, when combined with earlier work on these two parameters, suggest that they are alternative ways of magnifying a primary radiation event. (auth)

40611 EFFECT OF X-IRRADIATION IN SUBLETHAL TO SUPRALETHAL DOSAGE ON SERUM GLUTAMIC-OXALACETIC TRANSAMINASE. Frederick F. Becker, R. Bland Williams, Jr., and John L. Voogd (Naval Medical Research Inst., Bethesda, Md.). Radiation Res., 20: 221-6(Oct. 1963).

The exposure of albino rats to x-irradiation (250 kvp, 25 cm, HVL 2.3 mm Cu) at 30 and 298 r/min produced an elevation in serum glutamic–oxalacetic transaminase at several total doses. Dose-rate differences were evident, as the higher dose rate produced a more rapid and greater response. However, overlap at all doses decreased the dosimetric possibilities of this test. Correlative histologic studies indicate that the major source of serum glutamic–oxalacetic transaminase was lymphoid tissue, although crypt epithelium and bone marrow were probably involved. (auth)

40612 RADIATION PROTECTION BY CALCIUM GLUCONATE AND RECOVERY OF X-IRRADIATED CONIDIA OF NEUROSPORA CRASSA. J. Weijer (Univ. of Alberta, Edmonton, Can. and Atomic Energy of Canada, Ltd., Chalk River, Ont.). Radiation Res., 20: 227-46(Oct. 1963).

Evidence has been presented that certain doses of x rays stimulate the germination of Neurospora crassa conidia. In some cases this took the form of an increased plating efficiency over that at zero dose; in others it was apparent as a reduced death rate of conidia in comparison with that observed after lower doses. The stimulation is superimposed on the destructive effect of the radiation which becomes apparent at higher doses. In addition to x rays, low temperature and pH treatment were found to stimulate the germination of conidia. It is thought that these effects may be interpreted in terms of changes in cell permeability brought about by a common mechanism. The presence of calcium gluconate (25 mg/ml) during x-irradiation and the subsequent incubation on minimal plating medium of Neurospora crassa conidia caused an increase in the proportion that germinated. Postirradiation leakage of phosphorus-32 was largely prevented, even when x-ray doses as high as 7200 r were used, by the presence of calcium gluconate in the distilled water in which the conidia were irradiated. (auth)

40613 MOLECULAR RADIOBIOLOGY OF HUMAN CELL LINES. V. COMPARATIVE RADIOSENSITIZING PROPERTIES OF 5-HALODEOXYCYTIDINES AND 5-HALODEOXYURIDINES. R. L. Erikson and W. Szybalski (Univ. of Wisconsin, Madison). Radiation Res., 20: 252-62(Oct. 1963).

Under identical conditions, 5-bromo derivatives of deoxyuridine (BUdR) and deoxycytidine (BCdR) are incorporated to the same extent into the DNA of the human cell line D98/AG, producing approximately equal degrees of radiosensitization. An analogous conclusion holds true for 5-iododeoxyuridine (IUdR) and 5-iododeoxycytidine (ICdR), although the iodo analogs are less effectively incorporated into DNA than the bromo analogs. For the same degree of thymidine replacement, bromo derivatives are only slightly better ultraviolet light sensitizers than the iodo derivatives; on the other hand, the latter are much better x-ray sensitizers than the former. For all the compounds, but especially for the bromo analogs, the sensitization toward ultraviolet light is more pronounced than toward x rays. The x-ray sensitization by halo analogs does not seem to depend on the comparatively higher photoelectric absorption cross section of the halogen atoms, since the degree of sensitization is independent of the energy of the x rays. (auth)

40614 MODIFICATION OF SENSITIVITY TO X-IRRADIATION BY WATER IN BACILLUS MEGATERIUM. A. Tallentire and E. L. Powers (Argonne National Lab., Ill.). Radiation Res., 20: 270-87(Oct. 1963). (TID-18378; UAC-7155)

Dry spores of Bacillus megaterium were equilibrated at 25°C with partial pressures of H_2O ranging from 2.5×10^{-5} mm to 22 mm of mercury (= torr). After exposure to x rays rays, the spores with different water content were treated to permit recognition of the influence of varying amounts of H_2O in the spore on the previously described three main kinds of mechanisms responsible for lethal damage. Probability of damage from oxygen-independent causes is unchanged from about 10^{-5} torr to about 10^{-1} torr but may rise by about 20% as the vapor pressure is raised to saturation (22 mm at 25°C). Probability of damage from radiation-induced radicals that must combine with O_2 after formation decreases from the very dry (10^{-5} torr) spore to about one-third at 1 torr, remains constant to about 10 torr, and then decreases to zero at 22 torr. Water protects the spore from damage from these radicals, and to different degrees in two ranges of water content. Probability of damage observed only when O_2 is present at the time of irradiation decreases from a high value at 10^{-5} torr to about one-fifth that value at 1 torr, remains constant to about 10 torr, and then increases as vapor pressure of H_2O increases to saturation. Results are analyzed and discussed. Water is seen to have a very large over-all protective effect; at the same time, it can be shown to be sensitizing in two ways, one O_2-independent and one O_2-dependent, as water content approaches maximal values. The evidence allows recognition of three levels of water content, as well as interpretation of the action of protective chemicals in wet cellular systems. (auth)

40615 LOW-LEVEL CHRONIC GAMMA IRRADIATION AS A FACTOR IN AUDIOGENIC SEIZURES OF MICE. Julian P. Cooke (Agricultural and Mechanical Coll. of Texas, College Station). Radiation Res., 20: 298-302 (Oct. 1963).

The incidence of tetany after audiogenic seizure testing in offsprings of C57Bl × DBA/2 mice that were irradiated with 20 r of γ-irradiation delivered at the rate of 2 r/day for the first $10\frac{1}{2}$ days of gestation was significantly increased ($P < 0.01$) in both male and female mice. The female appears to display a greater sensitivity to irradiation, since her death rate was significantly increased ($P < 0.01$), equaling the death rate of the male, which did not change with irradiation. It thus appears that audiogenic seizure may be of value in serving as a biological indicator of low-level radiation damage. The fact that the reasons for the increased seizure susceptibility after chronic low-level γ-radiation are not understood does not lessen the usefulness of this new tool as the techniques become refined. The application of standardized stimuli, however,

will assist in obtaining reproducible results in different laboratories. (auth)

40616 THE EFFECT OF THE ADRENAL GLAND ON RADIATION-INDUCED CREATINURIA. Thomas R. Koszalka, Samuel S. Kurohara, Georg B. Gerber, and Louis H. Hempelmann (Univ. of Rochester, N. Y.). Radiation Res., 20: 309-16(Oct. 1963).

Adrenalectomized rats, sham-adrenalectomized rats, and adrenalectomized rats injected with hydrocortisone were exposed to 500 r of x irradiation. Twenty-four-hour urine samples were collected for four days before exposure and for five days after exposure to x irradiation. Samples of blood from the tail veins were also collected at various intervals. The degree of creatinuria was assessed by means of the creatine/creatinine ratio as well as by the daily urinary excretion of creatine. The results indicated that the presence of the adrenal gland is not a necessary prerequisite for the production of radiation-induced creatinuria. (auth)

40617 EXTENSION OF THE INTERSTIMULUS INTERVAL IN SACCHARIN AVOIDANCE CONDITIONING. William A. McLaurin and Barron B. Scarborough (Florida State Univ., Tallahassee). Radiation Res., 20: 317-24(Oct. 1963).

Thirty-eight male Sprague-Dawley rats were used as subjects in an investigation of the effect of three durations of interstimulus interval on the saccharin avoidance response with x-irradiation as the unconditioned stimulus (UCS). Interstimulus intervals of 10, 35, and 60 minutes with a conditioned stimulus (CS) period (saccharin solution presentation) of 10 minutes produced no differential effect in intensity and duration of the avoidance response over seven posttreatment days in subjects exposed to summated air exposure doses of 81.6 r at a dose rate of 10.2 r/min. The three irradiated interstimulus groups were significantly different in avoidance behavior from the sham-irradiated control group. A trend analysis of the saccharin index scores showed a significant positive extinction trend in all irradiated groups. It was concluded that under the conditions of this experiment the degree of avoidance behavior evidenced by the subjects in this study could not be attributed entirely to learning or to the conditioning process, and that radiation as a motivating stimulus has unique properties which differ from other nociceptive stimuli used in conditioning avoidance behavior. (auth)

40618 EFFECT OF TOTAL-BODY IRRADIATION ON THE RESPONSE OF TRANSPLANTED MOUSE TUMORS TO FRACTIONATED LOCAL RADIOTHERAPY. I. TUMOR RESPONSE, LONGEVITY, AND LATE CHANGES. Melvin R. Sikov, Bettina B. Cook, and James E. Lofstrom (Wayne State Univ., Detroit). Radiology, 81: 642-51(Oct. 1963).

Mice bearing subcutaneous implants of the L-1 lymphosarcoma or the Ehrlich carcinoma were subjected to multiple radiation exposures of the tumor. The radiation was administered over a range of fractionation patterns but within each experiment the overall time of exposure was kept constant. The responses obtained with local irradiation were compared to those obtained when the local doses were reduced and total-body irradiation was added to make up the total. The effects were measured in terms of tumor regression, median survival time, gross metastases, and late radiation changes. With tumors, it was found that the oncolytic effect of radiation was greatest as decreasing numbers of fractions were administered. Other parameters, such as late radiation changes, followed this same inverse relationship. With the L-1 lymphosarcoma, a substantial enhancement of effect was seen when a portion of the local tumor dose was replaced by 50 or 100 r of whole-body irradiation. This seemed to be independent of the magnitude of the total body dose, in accord with previous experiments using acute exposures. This potentiation by whole-body irradiation was not seen with the Ehrlich carcinoma. (auth)

40619 RADIATION-INDUCED CHROMOSOME ABERRATIONS IN MAN. Motomichi Sasaki, Richard E. Ottoman, and Amos Norman (Univ. of California, Los Angeles). Radiology, 81: 652-6(Oct. 1963).

A study was made of the production and elimination of radioinduced chromosomal aberrations in leukocytes from the peripheral blood of persons exposed to chronic or acute doses of high-energy radiation. Included in the group were radiologists and laboratory scientists, for whom there were available complete records of the radiation dose received during their working life, and a number of distinguished radiologists who have practiced more than 25 yrs and who may have received substantial doses.One of seven leukocytes from a distinguished radiologist contained a pair of chromosomes that could be classified as pseudo-diploid. In laboratory personnel for whom the doses received were significantly within the prescribed limits, the incidence of pseudo-diploid cells, of dicentrics, and of other chromosomal aberrations was significantly higher than in a more or less comparable control group. (tr-auth)

40620 EFFECTS OF triIODOTHYRONINE IN ALTERING THE RESPONSE OF KIDNEYS TO COBALT-60 RADIATION. William L. Caldwell, Robert W. Thomassen, and Antonio Bosch (Rodriguez U. S. Army Hospital, Army Tropical Research Medical Lab. and Puerto Rico Nuclear Center, San Juan). Radiology, 81: 657-63(Oct. 1963).

The fear of inducing radiation nephritis restricts the amount of radiation delivered to retroperitoneal tumors. If this radiation injury could be modified, the therapist would then be less fearful of possibly inducing this often fatal complication. Since triiodothyronine has proved beneficial in reducing radiation injury of the skin and subcutaneous tissues, the effects of this compound were evaluated following production of radiation injury in rabbit kidneys. Surprisingly, triiodothyronine did not favorably alter the reaction, but made it worse. The reason for this variance with the effects previously reported in skin is not certain. Tissue specificity or difference in vascularity may be important factors. The irradiated skin of the triiodothyronine-treated animals showed slightly less histologic alteration than the irradiated skin of the control animals. This tends to confirm the work of Glicksman and associates. (auth)

40621 X-RAYS: ARE THERE CYCLIC VARIATIONS IN RADIOSENSITIVITY? Roberts Rugh, V. Castro, S. Balter, E. V. Kennelly, D. S. Marsden, J. Warmund, and M. Wollin (Columbia Univ., New York). Science, 142: 53-6(Oct. 4, 1963).

When adult CF1 mice of either sex were x irradiated at various times of day and under various conditions of light and dark, their responses showed no cyclic variations. Radiodiagnosis and radiotherapy may be practiced with equal safety at all times. (auth)

40622 RADIATION DAMAGE TO ARTEMIA CYSTS: EFFECTS OF WATER VAPOR. Wallace C. Snipes and Walter Gordy (Duke Univ., Durham, N. C.). Science, 142: 503-4(Oct. 25, 1963).

Water vapor altered the form and greatly increased the rate of decay of the electron-spin resonance pattern of long-lived free radicals obtained upon gamma irradiation

of Artemia salina cysts (brine shrimp eggs). These results, combined with data on radiation survival, indicate that the water vapor protects the cysts from radiation damage, or heals the damage. They also indicate that water protects the cysts from the effect of oxygen by neutralizing the radiation-induced free radicals before they can interact with oxygen to produce irreversible damage. (auth)

40623 DESTRUCTION OF CANCER CELLS WITH X RADIATION. O. Warburg, K. Gawehn, A. W. Geissler, and S. Lorenz (Max-Planck-Institut für Zellphysiologie, Berlin-Dahlem). Z. Naturforsch., 18b: 654-6(Aug. 1963). (In German)

It is probable that x radiation destroys cancer cells by hydrogen peroxide formation in the cells. The hydrogen peroxide formed outside the cells in the suspension liquid during the irradiation does not participate since it is broken up in the diffusion path from the cell surface to the nucleus. (tr-auth)

40624 BIOLOGICHESKOE DEISTVIE PADIATSII. VYPUSK 1. (Biological Effects of Radiation. Issue No. 1). Lvov, Publishing House of Lvov University, 1962. 104p.

Thirteen articles are included on radiation effects on growth, development, and metabolism in animal and plant organisms. Biochemistry, cytology, and effects of ionizing radiation in agriculture and crop improvement are also discussed. (R.V.J.)

40625 CELLULAR BASIS AND AETIOLOGY OF LATE SOMATIC EFFECTS OF IONIZING RADIATION. A Symposium held in London 27-30 March 1962. R. J. C. Harris, ed. London and New York, Academic Press, 1963. 369p. $12.00.

Separate abstracts were prepared on 32 papers included in this volume. Eight papers were previously abstracted and appeared in NSA. (C.H.)

40626 LEUKAEMOGENESIS: QUANTITATIVE ASPECTS AND CO-FACTORS. R. H. Mole (Medical Research Council, Harwell, Berks, Eng.). p.3-16 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Possible mechanisms for radioinduced leukemia are discussed. Data are reviewed from a number of studies on leukemia in humans where radiation was a possible etiological factor. It is pointed out that at present there is scientific proof only for an indirect mechanism of leukemogenesis, defined as a mechanism causing leukemia to originate in unirradiated cells. (C.H.)

40627 EFFECTS OF LOW X-RAY DOSES (0.1-1 r) ON HAEMOTOPOIESIS SHOWN BY CYTOLOGICAL AND HAEMATOLOGICAL STUDY AND ^{59}Fe INCORPORATION — A FOUR MONTHS' SURVEY. H. Maisin (Institut du Cancer, Louvain, Belg.). p.17-26 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Total-body irradiation of rats with 0.1 r and 1 r, administered between 7 and 84 days before, does not modify the mortality following subsequent sublethal x-ray exposure. Although such a low dose does not affect the chance of survival of the rats from a later lethal dose, the number of cells/mg of marrow and the erythropoiesis as measured by the Fe^{59} incorporation in the red cells are, however, significantly increased between the 4th and 8th weeks after 1 r. Iron-59 incorporation in the red cells alone, 4 and 6 weeks after 0.1 r, is also increased. The number of reticulocytes in the peripheral blood significantly increases during the 2 to 4 weeks after 1 r and 0.1 r; whereas the red and white cells do not change. The significance of these results is discussed. (auth)

40628 THE EFFECT OF SINGLE AND FRACTIONATED DOSES OF IRRADIATION ON THE HAEMATOPOIETIC SYSTEMS OF C_{57}BL MICE. P. C. Koller and Valerie Wallis (Chester Beatty Research Inst., London). p.35-9 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Results are reported from studies on the effects of single and fractionated doses of x radiation on the hematopoietic system of mice during the pre-leukemic period. It is concluded that the cumulative effects of fractionated doses are significant contributory factors in the pre-leukemic process. (C.H.)

40629 NEW EVIDENCE ON THE MECHANISM OF RADIATION LEUKAEMOGENESIS. I. Berenblum and N. Trainin (Weizmann Inst. of Science, Rehovoth, Israel). p.41-56 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Results are reported from studies on the mechanism of radiation leukemogenesis in mice in which a radiation-urethan two-stage system was used to test the action of radiation and that of urethane in separate animals. Transmissible factors, such as virus or precursor-virus, liberated or already present in the irradiated animals were transferred to normal animals by the injection of tissues from irradiated animals and the induction of leukemia by urethan treatment measured. The results suggest that whole-body irradiation in mice of a low-leukemia strain causes the rapid appearance of a transmissible factor which, though itself not capable of transmitting the disease to other mice, does render recipients subject to leukemia induced by urethan treatment. The possibility that the transmissible factor is a dormant tumor cell is considered unlikely since it was distributed in all body tissues tested within 24 hr of irradiation. Preliminary results from studies on the incidence of leukemia in mice receiving cell-free extracts of tissues from irradiated mice show an increase after urethane treatment. Possible mechanisms involved in leukemia induction are discussed. (C.H.)

40630 A COMPARATIVE STUDY OF THE LATE EFFECTS OF CERTAIN RADIOMIMETIC DRUGS AND X-RAYS. L. Németh (State Oncological Inst., Budapest). p.57-8 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

In preliminary experiments using, first rabbits and then mice, it was established hematologically that 25 r whole-body x irradiation corresponded to 5 mg of Degranol or 50 mg of Mannitol-myleran. Groups of 50 male and 50 female mice, 2 months old and weighing 15 g, of a susceptible strain and of one not susceptible to spontaneous leukemia, were given for 1 year, weekly intraperitoneal injections of 5 mg/kg of Degranol, 50 mg/kg of Mannitol-myleran, and physiological saline, respectively. Another group of the same number and composition was x-irradiated with 25 r. An additional 1000 untreated and unhandled animals were used as controls throughout the experiment. Once a week, quantitative and qualitative white blood cell counts were taken of every experimental animal, including those given saline, but only of random samples from among the controls. All animals were weighed systematically, initially twice and later once a week. After the third month a pro-

portion of the mice was paired. Following the 52nd week all surviving mice were killed and subjected to histology. Early hematological response to the three treatments varied but all treatments increased the incidence of lymphatic leukemia. (C.H.)

40631 SERIAL TRANSPLANTATION OF HAEMATOPOIETIC TISSUE IN IRRADIATED HOSTS. P. C. Koller and S. M. A. Doak (Chester Beatty Research Inst., London). p.59-64 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

A group of 30 mice were given 650 r (LD_{99}) x radiation and 24 hr later each mouse received an injection of bone marrow cells from nonirradiated donors. After 28 days the marrow from six of the primary isogenic chimeras was used as donor tissue for injection into a second group of 30 irradiated hosts, thus making secondary chimeras. Five serial transplants of marrow were made. Analyses of the peripheral blood of untreated mice, marrow donors, and the survivors of each group before and after irradiation showed that in isogenic chimeras the peripheral blood picture was abnormal and remained so for some time. The bone marrow was altered by successive transfers into irradiated recipients. The relation of these changes to leukemia was not established. (C.H.)

40632 CHROMOSOMES IN MURINE PRE-LEUKAEMIA. P. L. T. Ilbery (Univ. of Sydney), P. A. Moore, S. M. Winn, and C. E. Ford. p.83-92 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Results are reported from a cytogenetic analysis of metaphase chromosomes in established radioinduced leukemia cells in mice. Mice in the pre-leukemia phase were also sampled for evidence of karyotype alteration in an attempt to determine whether chromosomal anomaly or the malignant change appeared first. (C.H.)

40633 THE CHROMOSOMES IN VIRUS-INDUCED MURINE LEUKAEMIAS. P. C. Koller, E. Leuchars, C. Talukdar, and V. Wallis (Chester Beatty Research Inst., London). p.93-102 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Results are reported from an analysis of chromosomes in cells of spontaneous and virus-induced leukemia in mice. Attempts were made to find some relation between irregular chromosome number and the leukemogenic process. (C.H.)

40634 CHROMOSOME ABNORMALITIES AND THE LEUKAEMIC PROCESS. J. Lejeune (Institut de Progénèse, Paris). p.103-6 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

The role of chromosomal changes in the occurrence of leukemia is discussed. Data are reviewed from studies of chromosome anomalies in chronic myeloid leukemia, acute myeloblastic leukemia, and mongolism. The possible association of mongolism with leukemia is suggested. (C.H.)

40635 QUANTITATIVE ASPECTS OF EXPERIMENTAL LEUKAEMOGENESIS BY RADIATION. R. H. Mole (Medical Research Council, Harwell, Berks, Eng.). p.107-11 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

When considering possible mechanisms for leukemogenesis by radiation, the following experimental observations need to be taken into account. Irradiation need not increase leukemia incidence, it may decrease it. Continuing irradiation need not lead to a continuing increase in leukemia. The effect of fractionation depends on the size of the total dose. Dose rate may be significant of itself. Because of the curvilinear relation between leukemia incidence and dose, experiments on physiological and other factors affecting the induction of leukemia by radiation cannot be interpreted easily unless dose-response curves in the different experimental situations are compared. (auth)

40636 EFFECTS OF IONIZING RADIATION ON CELLULAR COMPONENTS: ELECTRON MICROSCOPIC OBSERVATIONS. H. Cottier (Universität, Bern), B. Roos, and S. Barandun. p.113-18 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Lymphatic, bone-marrow, and liver tissues of adult mice and rats given short term whole-body x irradiation with 600, 700, and 1,000 r were examined by electron microscopy at early intervals after exposure. The first detectable changes appeared in the nuclei of radiosensitive cells (chromatin derangement with focal condensation, margination, and edema) at approximately 15 min post-irradiation. Apparent membrane fading (real or due to tangential sectioning) was more often seen in irradiated than in nonirradiated cells, but no precise evaluation of this finding is possible without serial sectioning. No morphologic evidence was found for intracentriolar damage as the cause of radiation-induced mitotic delay. (auth)

40637 CARCINOGENESIS. A. Gluecksmann (Strangeways Research Lab., Cambridge, Eng.). p.121-33 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

The induction of cancer by localized external or internal radiation or by whole-body exposure is discussed. Results are reported on the induction of skin tumors in mice and rats by chemical carcinogens. The tumor yield and duration of tumor induction time for chemical and radiation carcinogenesis are compared for mice and rats. Malignant changes observed in the cells are described. It was concluded that the descendants of cells treated with carcinogenic hydrocarbons produce cancers, whereas most, if not all, of the cells exposed to x rays are killed and cancers are formed in the regenerating tissue involved in repair. This interaction of hormonal and other factors in the induction of tumors by radiation is discussed. (C.H.)

40638 THE EFFECT OF X-IRRADIATION COMPARED TO AN APPARENTLY SPECIFIC EARLY EFFECT OF SKIN CARCINOGENS. F. Devik (Statens Radiologisk-Cysiske Laboratorium, Montebello, Oslo, Norway). p.135-8 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Formazan deposition in the epidermis of mice was measured after the application of 3 noncarcinogenic compounds, 3 carcinogenic compounds, and x radiation doses of 500 to 2,700 r. Results indicate that a functional disturbance of mitochondria may be common to chemical carcinogens and x radiation, but no close parallelism was demonstrated between the carcinogenic effects of chemicals and x radiation as determined by this early test for possible skin cancer. (C.H.)

40639 LONG-TERM CONSEQUENCES OF ^{90}Sr IN RATS AND THE PROBLEM OF CARCINOGENESIS. K. Sundaram (Atomic Energy Establishment, Trombay,

India). p.139-44 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Data on the long-term effects of Sr^{90} in rats were analyzed with regard to the fraction retained and the consequent biological effects. Young animals retained 33 times as much Sr^{90} as older animals. A comparison of the incidence of leukemia and osteogenic sarcoma 5 months after the administration of various doses of Sr^{90} in drinking water indicated that at low levels of skeletal burden of Sr^{90} the primary delayed somatic effect is leukemia, at intermediate levels leukemia and osteogenic sarcoma, and at high levels only osteogenic sarcoma. It is pointed out that the nonuniformity of distribution of Sr^{90} in the bone makes it difficult to compute the dose rate or total dose received by any cells. (C.H.)

40640 THE INFLUENCE OF RADIATION ON THE SURVIVAL OF MICE INJECTED WITH ASCITES TUMOUR CELLS. V. Drášil (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). p.145-7 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Mice irradiated with doses of 20, 60, and 180 r x radiation either 1 day or 30 days prior to the injection of Ehrlich ascites tumor cells developed tumors at a faster rate and died after a shorter period than nonirradiated tumor-injected mice. Possible mechanisms of the influence of radiation on tumor incidence are discussed. (C.H.)

40641 RADIATION-INDUCED BONE TUMOURS—FRACTIONATION STUDIES. J. P. M. Bensted, N. M. Blackett, V. D. Courtenay, and L. F. Lamerton (Royal Cancer Hospital, London). p.149-59 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

The effect of radiation dose fractionation on bone tumor production in young rats was studied using injected P^{32} as a β source, injected Pu^{239} as an α source, and localized external x irradiation. Fractionation of the dose of P^{32} increased the incidence of bone tumors and shortened the time before the onset of tumor development; fractionation of the dose of Pu^{239} produced no marked difference in tumor incidence but lessened development time; and fractionation of the dose of x radiation did not increase tumor incidence, but possibly lessened the incidence of tumors. (C.H.)

40642 CARCINOGENESIS AS THE RESULT OF TWO INDEPENDENT RARE EVENTS. R. H. Mole (Medical Research Council, Harwell, Berks, Eng.). p.161-9 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

The human evidence on the increase in cancer incidence in survivors of the atom bomb explosion at Hiroshima, which varied with the age of the individual at the time of exposure, and the animal evidence relating quantity of bone-seeking isotope and bone cancer incidence are both compatible with the general hypotheses that cancer arises as a result of two independent rare events. (auth)

40643 NON-NEOPLASTIC LATE EFFECTS. R. Brinkman (Rijksuniversiteit, Groningen, Netherlands). p.179-87 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

A short comparison of aging and late radiation effects leads to considerations on molecular, cellular, and nuclear life spans. Most attention is paid to aging and radiation changes of mucopolysaccharide tissue matrix with embedded fibers. This converges on the hypothesis of basal membranes being an important structure from which aging by irradiation might be understood. Examples cited are aortic intimal and glomerular basal membranes. (auth)

40644 INITIAL X-RAY EFFECTS ON THE AORTIC WALL AND THEIR LATE CONSEQUENCES. H. B. Lamberts (Rijksuniversiteit, Groningen, Netherlands). p.207-11 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Effects of x irradiation in vivo and in vitro on the aortic wall are described. Examples cited include increased atheromatosis in hypercholesterolemic rabbits, drop of injection pressure in the aortic wall, and increased permeability for several dyes. The importance of the radiosensitivity of the mucopolysaccharide matrix is stressed. The possibility of chemical protection of this matrix by $Na_2S_2O_3$ is discussed. (auth)

40645 THE RESPONSE OF TISSUES TO CONTINUOUS IRRADIATION. L. F. Lamerton (Royal Cancer Hospital, London). p.213-20 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Studies on the response of epithelial cells in intestinal crypts and hematopoietic tissues in young rats showed that intestinal epithelial cells may develop a resistance to radiation. No evidence of the development of radiation resistance was found in hematopoietic tissues, although erythropoietic activity was found to be less radiosensitive than the formation of white cells and blood platelets. (C.H.)

40646 THE CHOLESTEROL CONCENTRATION IN ADRENAL GLANDS OF HYPOPHYSECTOMIZED-GRAFTED RATS (WITH AND WITHOUT DESTROYED MEDIAN EMINENCE) AFTER WHOLE-BODY EXPOSURE TO A LETHAL DOSE OF X-RAYS. P. N. Martinovitch, D. Pavić, D. Sladić-Simić, and N. Živković ("Boris Kidrič" Inst. of Nuclear Sciences, Belgrade). p.221-7 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

It was found that pituitary transplants in hypophysectomized rats grafted in a heterotopic position (anterior eye chamber) restore to a considerable degree the weight and the function of the testes and the adrenal glands. When these rats were exposed to a whole-body lethal dose of x rays (850 r) a significant fall in the concentration of cholesterol in the adrenal glands was obtained. When the median eminence of hypophysectomized-grafted rats was destroyed by a micro-coagulation technique and 3 months later the experimental animals were exposed to 850 r of x rays a fall in cholesterol was obtained that was still significant but considerably lower than if the median eminence were left intact. Results obtained with testes after the median eminence had been destroyed proved too inconsistent to allow interpretation. (auth)

40647 MECHANISMS OF LIFE-SPAN SHORTENING. H. J. Muller (Indiana Univ., Bloomington). p.235-45 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Reasons are presented for concluding that spontaneous aging is a part of normal development caused, like most other developmental changes, by other factors than permanent genetic alterations such as point-mutation, deficiency, chromosome loss and inactivation, or segregation, even though it does involve the point-wise death of many indi-

vidual somatic cells. These reasons comprise the partial reversibility of natural aging, and its independence of ploidy and of other features of chromosome structure. Judged by the same criteria, radioinduced shortening of the life span is an expression of point-wise losses of individual cells that are caused by actual genetic changes. That the changes are for the most part recessive, depending on either point-mutations, deficiencies, or whole-chromosome losses, is shown by results in Drosophila, Habrobracon, and plant material, when effects on individuals of different ploidy are compared. Tests of diverse kinds carried out with Drosophila having chromosomes of different structural constitution show clearly that the mechanism here at work is that of chromosome loss, caused by radioinduced chromosome breaks. It is believed that the same basic mechanism accounts also for most of the acute damage that is produced by radiation. (auth)

40648 DETECTION OF SEGMENTARY HETEROCHROMIA IN FOETUSES IRRADIATED IN UTERO. J. Lejeune and M.-O. Rethore (Institut de Progénèse, Paris). p.247-50 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Segmentary heterochromia of the iris was studied as a possible somatic effect of in utero irradiation. Observations of mothers irradiated on the pelvis or the abdomen during pregnancy were systematically searched for in the files of a large maternity hospital. For each case, the mode of irradiation and the date of application, were recorded. The period from 1946 to 1954 was covered. The irradiated children are now between 8 and 18 yr old, a fact which simplifies all the investigations concerning pigmentation. The frequency of heterochromia of the iris was much greater in children irradiated in utero than in nonirradiated children. (C.H.)

40649 THE FAILURE OF THE POTENT MUTAGENIC CHEMICAL, ETHYL METHANE SULPHONATE, TO SHORTEN THE LIFE-SPAN OF MICE. Peter Alexander and D. I. Connell (Chester Beatty Research Inst., London). p.259-65 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Mice of the CBA strain were injected with large doses of the very powerful mutagenic agent, ethyl methane sulfonate (EMS). The treatment had no effect on the average life span although it did elicit a high incidence of tumors late in life. This observation suggests that the pronounced life span shortening seen in comparable experiments after treatment with x rays and the bifunctional alkylating agents, myleran and chlorambucil, cannot be attributed to the induction of somatic mutations since, by analogy with data from Drosophila, the dose of EMS used will induce many more mutations than the three treatments which shortened the life span of mice. It was concluded that a nongenetic cause must be sought for the reduction of life expectancy which occurs in CBA mice after large doses of x rays and which under the irradiation regime used is not due to a carcinogenic or leukemogenic action. The fact that all the life-span shortening agents known are cytotoxic to dividing cells suggests that late disorders may be due to incomplete repair of the massive cell death that occurs at the time of treatment in organs where mitosis is high. Delayed cell death in organs with low mitotic rate may be another important factor. The deduction that somatic mutations have no part in radiation life span shortening refers only to the particular situation studied. (auth)

40650 DOES RADIATION AGE OR PRODUCE NON-SPECIFIC LIFE-SHORTENING? R. H. Mole (Medical Research Council, Harwell, Berks, Eng.). p.273-6 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

The older mice are at the time of irradiation the less the life-shortening effects of single exposures to radiation and of daily irradiation for the duration of life. Since natural aging and radioinduced life shortening were not additive, it seems unlikely that radiation causes nonspecific life shortening in the sense that it ages the organism in some general over-all way. (auth)

40651 DIFFERENCES BETWEEN RADIATION-INDUCED LIFE-SPAN SHORTENING IN MICE AND NORMAL AGEING AS REVEALED BY SERIAL KILLINGS. Peter Alexander and D. I. Connell (Chester Beatty Research Inst., London). p.277-83 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Mice that had received in several fractions a total dose of 1,100 r of x rays were killed at monthly intervals and the histopathology of selected organs examined. The results of the first two years of the investigation are reported. The onset of some diseases and their incidence is quite unaffected by irradiation; for other diseases the latent period is the same, but the incidence is higher in the irradiated group. In yet others radiation advanced the time of appearance without altering the incidence. In addition, whole-body irradiation produces diseases that are not found in normal mice. These studies do not support the view that radiation-induced shortening of life span can be described as an acceleration of normal aging since this would require that the latent period of all diseases was advanced, but their incidence remains unaffected. It is concluded that other experiments, in which the time-course of the various diseases was determined from post-mortem examinations of mice that had been allowed to die, can be misleading and that the method of serial killing is more reliable. (auth)

40652 THE MODIFICATION OF THE LATE EFFECTS OF IONIZING RADIATION. O. C. A. Scott (Mount Vernon Hospital and Radium Inst., Northwood, Middx, Eng.). p.301-7 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Results are reviewed from a number of studies on the modification of the late pathological effects of radiation by chemical agents. Difficulties encountered in the studies are discussed. It is concluded that chemical protection is less effective against late effects of radiation than against immediate effects. (C.H.)

40653 APPARENT RADIATION PROTECTION AGAINST LOCAL AGEING EFFECTS IN THE SKIN OF MICE. Herman B. Chase (Brown Univ., Providence). p.309-11 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

Rejuvenation of the irradiated skin of mice was observed after continued plucking of hair. Possible explanations are discussed. (C.H.)

40654 DEPENDENCE ON RADIATION-INDUCED LIFE-SHORTENING ON DOSE-RATE AND ANAESTHETIC. P. J. Lindop and J. Rotblat (St. Bartholomew's Hospital, London). p.313-18 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

The amount of life shortening in mice induced per 100 rads of x radiation was calculated. The protective effects of anesthetic agents against both acute and long-term effects of radiation were observed to diminish with increasing dose rate. (C.H.)

40655 EFFECTS OF POST-IRRADIATION INJECTION OF YEAST SODIUM RIBONUCLEATE AND ITS NUCLEOTIDES ON THE DIFFERENTIAL COUNT OF BONE-MARROW. H. Maisin (Institut du Cancer, Louvain, Belg.). p.319-25 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

The total number of marrow cells/mg of marrow, the number of white and red cell precursors, and the number of reticular cells at different time intervals after a LD_{50} and a LD_{100} x ray dose in rats, control irradiated, or injected with yeast RNA or its nucleotides directly after irradiation were counted. Nucleotides were toxic at LD_{100}. In the ribonucleate- or nucleotide-injected rats a faster regeneration of the marrow red and white precursors, but particularly of the white, was observed. The regeneration of the red precursors was no longer possible after LD_{100}, and that of the white was reduced. It was not possible to show a definite regeneration of the reticular cells but their transformation into white and red precursors must have been facilitated. The significance of these results is discussed. (auth)

40656 THE EFFECTS OF TOTAL-BODY X-IRRADIATION ON THE REPRODUCTIVE GLANDS OF INFANT FEMALE RATS. D. Sladić-Simić, N. Živković, D. Pavić, and P. N. Martinovitch ("Boris Kidrič" Inst. of Nuclear Sciences, Belgrade). p.327-34 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

The effects of total-body x irradiation on the reproductive glands of 8- and 17-day-old female rats were studied after exposure to doses of 400, 200, 100, and 50 r. Three-month-old adult females, serving as controls, were irradiated with doses of 400 and 200 r. The effects of the various doses upon the reproductive glands, starting with the prepubertal period up to the first ovulation, were checked by counting the germ cells, by counting the mitotic divisions within the follicles, by measuring the volume of the ovaries, and by observing the fertility of the exposed rats as well as their F_1 and F_2 generations. The reproductive glands of 8-day-old rats proved to be most sensitive to x ray exposure. Less sensitive are those of 17-day-old rats, whereas the ovaries of 3-month-old irradiated rats are least sensitive. In 8-day-old rats, irradiation with a dose of 100 r caused destruction of a large number of primary oocytes, but an accelerated development of a few of them. A dose of 50 r induced the growth of a large number of follicles and thus reduce the existing number of primary oocytes. As a result, the litter size at first parturition of irradiated rats is larger than in controls. The F_1 and F_2 generations of the exposed females show a high percentage of dwarfism and mortality. (auth)

40657 PERIPHERAL BLOOD STUDIES UPON SOME ISOGENIC CHIMAERAS. A. J. S. Davies, Anne M. Cross, and P. C. Koller (Chester Beatty Research Inst., London). p.335-8 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation." London and New York, Academic Press, 1963.

The effect of isogenic bone marrow therapy upon survival and peripheral blood counts was measured in mice 10 days after various doses of whole-body x radiation followed or not by the intravenous injection of 10^7 bone marrow cells. The depression of all elements of the peripheral blood was proportional to the radiation dose. Injection of bone marrow hastened recovery from radiation injury in all cases. The effect of varying the number of bone marrow cells injected was also studied. The more cells injected, the more rapid was recovery from radiation injury of all components of peripheral blood. (C.H.)

40658 PULMONARY CANCER FROM DEPOSITED RADIOACTIVE MATERIALS IN THE LUNG. H. Cember (Univ. of Cincinnati). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/30, 15p. (CONF-104-26)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The pulmonary effects from radioactive materials are described, with special emphasis given to lung cancer. The results of studies by several investigators in experimental carcinogenesis are summarized, and experimental data on lung cancer in rats from radioactive materials are presented. The focal nature of radiation dosage from insoluble particulates is discussed, and comparative data on carcinogenic potency of soluble $Ce^{144}Cl_3$ and insoluble $Ce^{144}F_3$ are presented, which show the soluble form of the compound to be at least as potent a pulmonary carcinogen as the insoluble particulate. (auth)

Radiation Sickness

40659 (BNL-7207) RADIOBIOLOGICAL BASIS FOR THE WHOLE BODY RADIATION SYNDROME. Victor P. Bond and Theodor M. Fliedner (Brookhaven National Lab., Upton, N. Y.). July 19, 1963. Contract AT-30-2-GEN-16. 23p. (CONF-236-1)

From Joint Meeting of the German Roentgen Society and the Germany Biophysical Society, Baden-Baden, Germany.

Data are presented that show a marked species difference in the degree of damage, and in the course of events seen in the bone marrow and peripheral blood after a given dose of radiation. The data taken together indicate strongly, but do not prove, that the picture seen results primarily from damage to the stem cell population. This damage to the stem cells is manifested later in the more mature differentiating cells of the marrow, and in the peripheral blood. The picture seen results both from death of stem cells, and also injury leading to reduced proliferative capacity, with later death of the injured stem cell and all of its progeny. Thus the picture seen is a result of both quantitative and qualitative changes resulting directly from the exposure of the stem cells, and species differences relative to sensitivity and time course of events appear to depend to a large degree on differential sensitivity of the bone marrow stem cell populations to death and injury. (auth)

40660 (TID-18174) THE MEASUREMENT OF RESIDUAL ACUTE INJURY FROM SINGLE EXPOSURES BY SURVIVAL FOLLOWING DAILY IRRADIATION. Douglas Grahn and George A. Sacher (Argonne National Lab., Ill.). Dec. 1962. Contract W-31-109-eng-38. 20p. (UAC-7107)

A method is described for examining recovery kinetics in irradiated biological systems. Independent samples of animals are first subjected to different single whole-body doses of radiation; then, after some chosen time interval, all the samples are exposed to a constant daily dose of γ radiation for the duration of life. The daily exposure level

is chosen to cause a selected acute or subacute radiation syndrome, wherein death occurs between about 15 and 120 days from the start of exposure. The mean after-survival from the start of daily exposure is the endpoint statistic. The results of this method in studies in mice are compared with certain existing data, and some advantages and disadvantages of the method are discussed. (C.H.)

40661 (TID-18205) INCREASED INTESTINAL ELIMINATION OF N'-METHYLNICOTINAMIDE IN IRRADIATED RATS. L. E. Detrick, H. C. Upham, R. W. Springsteen, and T. J. Haley (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). [Mar. 21, 1963]. Contract AT(04-1)-Gen-12. 12p.

The influence of 525 r whole-body x irradiation on the intestinal absorption and elimination of N'-methylnicotinamide was investigated in rats. This material does not appear to be absorbed to any appreciable extent by the irradiated animal. A significant increase in elimination of this metabolite via the intestinal tract was found after irradiation, and the increase was maintained even when histological evidence of tissue repair was observed. The greatest increases in elimination were seen on days 3 and 5. The evidence presented seems to indicate that the pyridine nucleotide co-enzymes of the liver are involved in the increased intestinal elimination of N'-methylnicotinamide by the irradiated animal. This metabolite is excreted not only by the urinary tract but via the intestinal tract as well. (auth)

40662 (USNRDL-TR-661) ADULT THYMUS: LIMITED ROLE IN RECOVERY OF HOMOGRAFT RESPONSE IN IRRADIATED MICE. M. L. Tyan, L. J. Cole, and W. E. Davis (Naval Radiological Defense Lab., San Francisco). July 24, 1963. 10p. (AD-417894)

Thymectomized and sham-thymectomized adult LAF_1 and CBA mice received lethal irradiation and were protected with syngeneic bone marrow. Thirty days after irradiation the survivors were grafted with allogeneic and xenogeneic (rat) skin. The thymectomized mice rejected their rat grafts only slightly later than did the mice in the sham-thymectomy group; in contrast, allogeneic grafts survived significantly longer on the thymectomized mice than they did on the mice in the control group. (auth)

40663 (FTD-TT-63-641) CERTAIN VARIATIONS IN CARBOHYDRATE METABOLISM IN MONKEYS WITH ACUTE RADIATION SICKNESS. L. N. Polikarpova and A. Ya. Shulyatikova. Translated from Radiobiologiya, 2: 390-4(1962). 13p.

Certain changes in carbohydrate metabolism, expressed differently in different stages of the sickness, were observed in Rhesus monkeys with acute radiation sickness induced by acute x irradiation. After two or three days there was a noticeable enhancement of synthetic processes in the monkeys. Resynthesis of lactic acid was enhanced, which led to a drop of its level in the blood by 30 to 40% in comparison with the norm. The glycogen content increased in the skeletal muscles. Simultaneously, decomposition processes were observed which indicated a fall of the glycogen content in the liver, brain, and blood. In the preterminal period (5 to 8 days postirradiation), a gradually increasing drop in the glycogen content in the liver and skeletal muscles, and an increase in the lactic acid and sugar level in the blood were observed. This indicates a predominance of decomposition processes over synthesizing processes at this period, a decrease of oxidative processes in the organism, and liver disorders. (auth)

40664 ON THE QUESTION OF LATE RADIATION INJURIES TO HIGHER ORGANISMS BY INCORPORATION OF RADIOACTIVE FISSION PRODUCTS (I^{131}, Sr^{90}, Cs^{137}). H. Langendorff and H. Kriegel (Universitat, Freiburg i. B. and Heiligenberg-Institut, Ger.). Atomkernenergie, 8: 335-9(Sept. 1963). (In German)

The question of late effects in higher organisms after incorporation of the radioactive fission products I^{131}, Sr^{90}, and Cs^{137} is discussed in a comprehensive study of the literature. Special reference is made to those experimental investigations concerned with amounts or concentrations of radioisotopes or doses of irradiation in the tissues and which can serve as values defining minimal late effects. From this study of literature it was concluded that the present data are not sufficient for such definitions. A generally satisfactory fixation of MPD and MPC values for radioactive fission products cannot be expected prior to critical analysis of experiments concerning the biological behavior of these fission products and the radiotoxicology. With the example of these radionuclides, which are of special relation to humans, the importance is of further radiobiological investigations on the question of late effects after incorporation of radionuclides is stressed. (auth)

40665 SUBCUTANEOUS RESORPTION OF THYROXINE AND 3, 5, 3'-TRIIODO-L-THYRONINE IN THE NORMAL RAT AND IN THE RAT EXPOSED TO LETHAL X RADIATION. M. Morelle (Université, Liege). Compt. Rend. Soc. Biol., 157: 893-96(1963). (In French)

The velocity of the resorption of thyroxine, 3,5,3'-triiodo-L-thyronine, and NaI after subcutaneous injection was studied in normal white male rats and in rats exposed to a whole-body lethal x radiation. NaI was resorbed much more rapidly than thyroxine (T_4) and the thyronine (T_3). The triiodated hormone has a resorption velocity slightly higher than that of its tetraiodated homolog. The resorption velocity of NaI, T_4, and T_3 is not modified in the rat exposed five days before to a total x radiation dose of 800 r. (tr-auth)

40666 ABSENCE OF RADIOPROTECTIVE ACTIVITY OF PHENYLSELENOL IN THE MOUSE. Z. M. Bacq, C. Onkelinx, and G. Barac (Université, Liege). Compt. Rend. Soc. Biol., 157: 899-901(1963). (In French)

The radioprotective action of some molecules with the sulfhydrile function is well known. Because of the chemical similarity of S and Se, a substance with the SeH group, phenylselenol, was tested. This compound with a molecular weight of 157 is a yellowish oily liquid at room temperature. It is only slightly soluble in water, but soluble in olive oil. Mice injected with 0.4 mg/g body weight with phenylselenol developed intoxication signs within several minutes, but fatality did not result. A dose of 0.2 mg/g resulted in the same symptoms but with less severity. The mice were exposed to 700 r x radiation ten minutes after injection with these two doses of phenylselenol. There was no apparent modification in the mortalities. (J.S.R.)

40667 EFFECTS OF β-AMINOETHYLISOTHIOUREA (AET) ON MUTATIONS INDUCED IN MICE BY X RAYS. II. DECREASE OF THE RATE OF DOMINANT LETHALITY INDUCED IN SPERMATOZOIDS IRRADIATED WITH HIGH DOSES OF X RAYS. A. Léonard and J. R. Maisin. Compt. Rend. Soc. Biol., 157: 913-15(1963). (In French)

In a preceding study it was shown that the dibromohydrate of AET, injected intraperitoneally, does not increase the number of spontaneous lethals of non-irradiated mouse spermatozoids and does not decrease the number of dominant lethal mutants induced by irradiation of mouse spermatozoids with 400 r of x rays. The study was extended to x-ray doses of 1200 r. The results show that although AET reduces the lethal mutants induced in spermatozoids, the

degree of protection offered by this product is, however, much less than that offered to other radiosensitive organs as the intestine. The protection is also less than that given by cysteamine. (J.S.R.)

40668 COMPARED EXCRETION OF IODIDES IN THE NORMAL RAT AND IN THE RATS EXPOSED TO LETHAL X IRRADIATION. M. Lemaire (Université, Liege). Compt. Rend. Soc. Biol., 157: 920-2(1963). (In French)

In thyroidectomized rats, 75% of the iodide, injected subcutaneously as NaI in physiological liquid, administered in tracer doses, was excreted in the first 24 hrs. After the administration of a pharmacological dose, the excretion attains 90% in the same time interval. In animals exposed five days previously to whole-body lethal x radiation, the excretion of the iodide is not modified. The thyroid hypocaptation of the rat can not, therefore, be explained by a decrease in the renal clearance of iodides. (tr-auth)

40669 RESTORATION PROCESSES IN THE MUCOUS MEMBRANE OF THE DUODENUM AFTER INJURY BY RADIATION. I. A. Chalisov and L. B. Berlin (Kirov Military Academy of Medicine, USSR). Dokl. Akad. Nauk SSSR, 151: 1450-2(Aug. 21, 1963). (In Russian)

Changes in the mucous membrane of the duodenum were followed in 111 rats from 0 hours to 15 days after administering a single, Co^{60} dose of 900 r. The survival of the rats was 50% after 11 to 14 days. Parts of the duodenum were fixed in formaldehyde and wax, and paraffin sections 5 to 7 μ were stained with iron hematoxylin, eosin, red aniline dye, methyl green, and other reagents for the hematological studies. The mitotic coefficient dropped from a normal value of 5.4% to a low value of 0.05% a few hours after the irradiation in the epithelial cells of the mucous membrane. The mitotic coefficient increased to 1% after a few days. On the second day, destructive processes were noted which resulted in the loss of the entire epithelial covering of the duodenum and inflammation in the mucous membrane with a temporary disappearance of the villi. Restoration processes in the epithelium began on the third day with an increase in activity of the crypt cells from 2% to a final 5.7%. The epithelium began to differentiate and reform. The surface of the duodenum became almost smooth. New villi appeared in places. This period of intensive restorative changes in the duodenum coincides with the beginning of severe radiation sickness with bleeding in the animal. On the 10th day, the crypts and villi were normal in appearance and structure, even though 50% of the animals died from the severe radiation sickness on the 11th to 14th day. (TTT)

40670 REDUCTION IN THE EFFICIENCY OF THE PROTECTIVE EFFECT OF CYSTEAMINE FOLLOWING REPEATED EXPOSURE TO RADIATION. S. N. Aleksandrov and K. F. Galkovskaya. Dokl. Akad. Nauk SSSR, 152: 215-17(Sept. 1, 1963). (In Russian)

Mice were irradiated with a single, 800 r, dose of Co^{60} γ rays, or with four separate doses of 200 r spaced a week apart. An aqueous solution of cysteamine hydrochloride was intraperitoneally administered 10 to 15 minutes before irradiation at a dose of 0.15 mg/kg body weight. Cysteamine ascorbate was also used as a protective agent. The mice were given a 200 r dose, and the protective agent was administered seven days later. Then the mice were given three additional doses of 200 r each. The difference between the mortality in the control animals and that in the irradiated animals at the 30th day after the irradiation (A-B in the case of single exposure and a-b in the case of repeated irradiation) was taken as an index of the effectiveness of the protective activity of cysteamine. The difference (A-B) – (a-b) gives the effectiveness of the protective agent in the single exposure, as compared to the effectiveness of the fractionated irradiation.. It appears that the animals irradiated with a single dose of 800 r are protected by cysteamine to a greater extent than those treated with fractionated doses; this difference ranges from 24 to 29%. The ability of the amino-sulphydryl compounds to react with the free peroxide radicals, to lower the partial pressure of oxygen and to form complex bonds with the biopolymers is discussed. It is postulated that these phenomena might not play the same role in the case of single irradiation as in fractionated irradiation. The first 200 r dose lowered the resistance of the organism to withstand the effects of ionizing radiation even with subsequent administration of the protective agent. (TTT)

40671 ANTIGENIC PROPERTIES OF EXPERIMENTAL LEUKEMIAS. I. SEROLOGICAL STUDIES IN VITRO WITH SPONTANEOUS AND RADIATION-INDUCED LEUKEMIAS. Lloyd J. Old, Edward A. Boyse, and Elisabeth Stockert (Sloan-Kettering Inst. for Cancer Research, New York and New York Univ., New York). J. Natl. Cancer Inst., 31: 977-86(Oct. 1963).

Antisera prepared in C57BL/6 mice against several spontaneous or radiation-induced leukemias of strain A, or against a radiation-induced $(C57BL/6 \times A)F_1$ leukemia, were cytotoxic in vitro for the cells of 14 radiation-induced C57BL/6 leukemias and 1 C57BL/6 leukemia induced by urethan. These antisera were not cytotoxic for any of the normal C57BL/6 tissues studied. Specific cytotoxic activity was removed by absorption with those C57BL/6 leukemias that are sensitive in the cytotoxic test, but not by normal C57BL/6 tissue. Cytotoxic activity was removed by absorption with normal thymus of strains A, $(C57BL/6 \times A)F_1$, and C58, but not with normal thymus of several other strains, including C57BL/6. Normal strain A tissues, other than thymus, did not absorb specific cytotoxic activity. These serological data indicate the presence of a common antigenic component in certain C57BL/6 leukemias and in the normal thymus and leukemias of strains A and C58 origin. In conformity with presence of the antigen in the thymus of normal strain A mice, cytotoxic activity against strain A leukemias was not demonstrable in the sera of strain A mice immunized against cross-reacting C57BL/6 leukemias. (auth)

40672 ANTIGENIC PROPERTIES OF EXPERIMENTAL LEUKEMIAS. II. IMMUNOLOGICAL STUDIES IN VIVO WITH C57BL/6 RADIATION-INDUCED LEUKEMIAS. Edward A. Boyse, Lloyd J. Old, and Silvi Luell (Sloan-Kettering Inst. for Cancer Research, New York; Cornell Medical Coll., Ithaca, N. Y.; and New York Univ., New York). J. Natl. Cancer Inst., 31: 987-95(Oct. 1963).

The serum of C57BL/6 mice immunized against an A strain TL+ (thymus leukemia antigen) spontaneous leukemia was highly cytotoxic for the cells of several C57BL/6 leukemias. Paradoxically, this was not associated with resistance in vivo to the inoculation of 2 TL+ C57BL/6 radiation-induced leukemias highly sensitive to TL antisera in vitro. Leukemia cells recovered after their outgrowth in immunized C57BL/6 mice lost their sensitivity to TL antisera in vitro and their ability to absorb specific cytotoxic activity from TL antisera. A single further passage of these cells in normal untreated C57BL/6 hosts was accompanied by complete restoration of sensitivity, even after 3 consecutive passages in immunized hosts. Immunoselection, inadequate complementation, or interference by blocking an-

tibody might account for the outgrowth of TL+ leukemia cells in immunized hosts, but the present evidence does not favor these interpretations. More probably the temporary changes in antigenicity reflect an adaptational alteration affecting the entire population of leukemia cells. (auth)

40673 BIOLOGICAL-CHEMICAL PROTECTION AGAINST RADIATION. Ferenc Toth and A. Z. Borsod (Megye Council Hospital, Miskolc, Hungary). Magy. Radiol., 15: 193-200(Aug. 1963).

Chemical compounds that have a radioprotective effect and the mechanism of radioprotection are discussed. The use of bone marrow transfusion is also mentioned. (TCO)

40674 THERAPEUTIC POSSIBILITIES FOR INJURIES CAUSED BY INCORPORATED RADIOACTIVE SUBSTANCES. Bela Gimes (Medical Univ. of Budapest). Magy. Radiol., 15: 201-7(Aug. 1963).

The possibilities of treatment of radioactive intoxication were reviewed and are discussed. The importance of the problem is stressed because of the increasing number of people who come in contact with radioactive substances. (TCO)

40675 DATA ON THE MECHANISM OF LEUKOPENIA AND LEUKOCYTOSIS OCCURRING AFTER RADIATION THERAPY. Julia Gidali, Imre Feher, and Julia Osgyani. Magy. Radiol., 15: 232-9(Aug. 1963).

In rabbits irradiated with 150-600 r, granulopenia of short duration preceded the granulocytosis. The plasma, obtained from animals suffering from granulopenia, produces granulopenia and thrombopenia in normal animals. This is followed by granulocytosis. It was concluded that the substance, traceable in the plasma after irradiation and influencing the number of circulating granulocytes and thrombocytes, is not a toxin (leukotoxin), but a substance that also develops under the effect of physiological stimuli. (OTS)

40676 CHEMICAL PROTECTION AGAINST EARLY RADIATION MORTALITY OF THE YOUNG CHICKEN. J. L. Montour and C. J. Shellabarger (Univ. of Michigan, Ann Arbor). Proc. Soc. Exptl. Biol. Med., 113: 937-43 (Aug.-Sept. 1963).

The protective capacity of AET against early mortality in the young chicken was investigated. The results showed that AET given fifteen minutes prior to radiation exposure acts to protect the acutely irradiated chick from injuries leading to death in the early (0-48 hr) period, producing an effective dose reduction of approximately 200 r. Two distinct phases of mortality were seen within 48 hr of exposure. The first period, 3-9 hr post-exposure, was characterized by an approximately linear dose-mortality response above 750 r. In the second phase (17-30 hr) approximately 40% of the animals irradiated with 750 r died, no increase being observed with higher radiation doses. (P.C.H.)

40677 RADIATION DOSE-RESPONSE CHARACTERISTICS OF LEUCOCYTE RECOVERY IN THE MOUSE. Willie W. Smith, Ilo M. Alderman, Carol A. Schneider, and Jerome Cornfield (National Cancer Inst.; National Heart Inst.; and National Inst. of Health, Bethesda, Md.). Proc. Soc. Exptl. Biol. Med., 113: 1016-18(Aug.-Sept. 1963).

Conditions under which radiation dose-response increments result in significant response increments for granulocyte and lymphocyte recovery in the mouse are specified and a dose-response curve is given, which permits estimation of the dosage corresponding to a given level of response. The dose corresponding to a given time of recovery could be estimated with reasonable accuracy for granulocytes over the dose range 275-770 rads and for lymphocytes over the range 450-770 rads. For granulocytes recovery time increased 42% and for lymphocytes 30% per 100 rad dose increment. It was concluded that dose-response characteristics of recovery times are useful in distinguishing between dose-reducing effects and effects relating specifically to recovery processes. (P.C.H.)

40678 SURVIVAL OF LETHALLY X-IRRADIATED RATS RECEIVING MARROW FROM NORMAL OR CHLORAMBUCIL-TREATED DONOR RATS. Richard A. Kielar and Howard A. Meineke (Univ. of Cincinnati). Radiation Res., 20: 1-7(Sept. 1963).

Marrow from chlorambucil-treated rats induced a higher survival rate when transfused into rats exposed to lethal whole-body x radiation than did the same amount of marrow from normal rats. Differential counts of the marrow from the chlorambucil-pretreated donor rats revealed several alterations in the cellular composition, most of which indicated that the treated marrow contained a greater number of immature cells known to have a higher mitotic index. (auth)

40679 CLEARING FACTOR LIPASE AND THE IRRADIATION SYNDROME. D. G. Baker and F. C. Monkhouse (Univ. of Toronto). Radiation Res., 20: 8-16(Sept. 1963).

In rats exposed to 800 r of whole-body x radiation, the clearing factor lipase (CFL) activity of plasma remained elevated for about 7 days, compared to that of pair-fed controls. Irradiation of the liver region only failed to produce this effect. Orally administered olive oil failed to have a radioprotective effect. An elevated, heparin-induced plasma CFL activity during the irradiation or throughout the first 5 days postirradiation was associated with an increased 30-day mortality. (auth)

40680 LEUKEMIA INCIDENCE AND LONGEVITY IN RADIATION-INDUCED HOMOLOGOUS MOUSE CHIMERAS. William E. Davis, Jr., Leonard J. Cole, William A. Foley, and Victor J. Rosen, Jr. (Naval Radiological Defense Lab., San Francisco). Radiation Res., 20: 43-52(Sept. 1963).

In connection with studies on lymphoid cell chimerism and homograft tolerance in long-lived homologous (allogeneic) radiation chimeras, data were collected on life span and on occurrence of leukemia and other lesions. The chimeras were (C57L × A)F_1 hybrid mice (10 to 12 weeks old) exposed to 880 rads of x radiation and injected with bone marrow cells from C3H donors. Out of a total of 119 mice combined from several subgroups, 65% were dead by age 32 weeks (20 weeks after marrow injection), with gross symptoms of secondary disease evident in the great majority. Relatively few deaths occurred between 32 and 75 weeks, and the maximum life span was 105 weeks. Histopathological data were obtained from many of these long-lived chimeras and also from a group of long-lived isologous (syngeneic) marrow chimeras. There was an 80% incidence of glomerulosclerosis of moderate to severe degree, and a 20% incidence of arteriolarsclerosis in the kidney and spleen of the mice in both groups. Leukemias were observed in 5 out of 54 (9%) homologous chimeras, but none was found in the isologous chimera group. Some possible explanations for the increased incidence of leukemia in homologous chimeras as opposed to isologous chimeras are discussed briefly. (auth)

40681 DEOXYCYTIDINE IN URINE OF HUMANS AFTER WHOLE-BODY IRRADIATION. Helen K. Berry,

Eugene L. Saenger, Harold Perry, Ben I. Friedman, James G. Kereiakes, and Carolyn Scheel (Univ. of Cincinnati). Science, 142: 396-8(Oct. 18, 1963).

Increased levels of deoxycytidine were found in the urine of two humans during the first 24 hours after irradiation. This substance presumably was produced by the breakdown of DNA following irradiation, or resulted from interference with the synthesis of DNA. (auth)

CHEMISTRY

General and Miscellaneous

Refer also to abstract 40427.

40682 (HW-76867) SINGLE STEP REACTOR DECONTAMINANT FOLLOWING URANIUM FUEL CLADDING FAILURES. Invention Report. R. D. Weed (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 5, 1963. Contract AT(45-1)-1350. 7p.

Decontamination of a high-temperature pressurized-water reactor after fuel cladding failures requires the dissolution of uranium oxides for removal. The use of a oxalic–peroxide–peracetic solution for the dissolution involves the danger of explosion of the peracetic acid. A solution which is safer and also more effective in dissolving uranium and its oxides was formulated and consists of the following: oxalic acid, 2.3 g/l; sodium oxalate, 32.0 g/l; hydrogen peroxide, 15.0 g/l; 8-quinolinol, 1.0 g/l; gluconic acid (50%), 5.0 g/l; and sodium gluconate, 10.0 g/l. The data for dissolution of uranium oxides and corrosion of construction materials by this solution are tabulated. It is shown that the solution is less corrosive to brass and brass alloys than the oxalic–peroxide–peracetic solution. (D.L.C.)

40683 (ORNL-3482) TRANSURANIUM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING FEBRUARY 28, 1963. W. D. Burch, comp. (Oak Ridge National Lab., Tenn.). Oct. 8, 1963. Contract W-7405-eng-26. 68p.

The development of separation processes for the transuranium elements, process equipment development, HFIR target fabrication development, design of the TRU Facility, design of development facilities, corrosion studies, and analytical research and development studies are reported. (auth)

40684 (ORNL-TM-608) CHEMICAL TECHNOLOGY DIVISION, UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, APRIL 1963. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Oct. 16, 1963. Contract W-7405-eng-26. 76p.

Hydraulic study of a 24-in. dia foam column showed poor distribution of the liquid feed compared to the 6-in. dia column. A mathematical model for the combined reaction of hydrogen and carbon monoxide with copper oxide has been confirmed with experimental data. A summary of flooding rates and holdup data is reported for pulse columns operated at flow ratios (A/O) of 5, 50, and 100. The status of irradiation tests of ThO_2–UO_2 and ThO_2–PuO_2 prepared by the sol gel process is reported. Tests of mechanical components for the Tru processing cell are reported. A numerical solution of the kinetic equations describing the sorption of UF_6 on NaF pellets is presented. Waste calcination run R-74 was made with simulated Purex FTW-65 containing organic. (auth)

40685 ENERGY TRANSFER MECHANISMS AND THE MOLECULAR EXCITON MODEL FOR MOLECULAR AGGREGATES. Michael Kasha (Florida State Univ., Tallahassee). Radiation Res., 20: 55-71(Sept. 1963).

The molecular exciton model is defined as the resonance interaction between the excited states of loosely bound molecular aggregates (molecular crystals, nonconjugated polymers, molecular laminae, molecular dimers, and trimers). The Simpson and Peterson vibrational-electronic coupling cases are applied to spectral characteristics of molecular aggregates. The quasi-classical electrostatic vector model is described for simple molecular aggregates as an approach to understanding the formation of the exciton-state formation. Selection rules and exciton band structures are described for several molecular aggregate structures in the strong-coupling exciton model. In strong-coupling exciton cases, pronounced spectral effects of molecular aggregates compared with individual molecules are predicted, with very fast resonance transfer rates ($\gtrsim 10^{13}$/sec) depending on the inverse cube of intermolecular distance. In weak-coupling exciton cases, no conspicuous spectral changes are predicted, but the transfer rates are still high ($\sim 10^{12}$ to 10^{13}/sec) and preserve the inverse-cube intermolecular distance dependence. Förster's vibrational-relaxation resonance transfer mechanism is emphasized as a contrasting mechanism based on a different theoretical origin (interaction of continua model), with inverse sixth-power dependence on intermolecular distance and much slower transfer rates (10^6 to 10^{11}/sec). Emphasis is placed on the need for new discriminative experimental work. (auth)

40686 ENERGY TRANSFER PHENOMENA AND DISSOCIATION PROCESSES IN ELECTRONICALLY EXCITED MOLECULES. John L. Magee (Univ. of Notre Dame, Ind.). Radiation Res., 20: 71-6(Sept. 1963).

It is clear on general theoretical grounds that aggregation of molecules affects their dissociation processes and that this effect is of importance for chemical transformations produced by high-energy radiations. It is also clear that standard forms of exciton theory are not adequate to describe this effect. Results of a study of molecular dissociation using a simple model are discussed. Further work in this area is very much needed. (auth)

40687 EXCITON THEORY BY SECOND QUANTIZATION. Roald Hoffmann (Harvard Univ., Cambridge, Mass.). Radiation Res., 20: 140-8(Sept. 1963).

Agranovich's solution of the molecular exciton problem, in which the representation of second quantization is used, was outlined. The assumptions of the theory, in particular the manipulation of excitons as bosons, were stressed. This technique allows a closed solution without the use of a perturbation expansion and formally simplifies the consideration of interactions with photons or phonons. Previous calculations implying major disagreement between second quantized results and those obtained by first-order perturbation theory are incorrect. A detailed comparison of the two theories for a perfect one-dimensional aggregate shows in general good agreement. Thus the use of either formalism is valid, the choice dictated by convenience of one or the other in the particular problem studied. (auth)

40688 VIBRONIC STATES OF DIMERS. R. E. Merrifield (E. I. du Pont de Nemours and Co., Wilmington, Del.). Radiation Res., 20: 154-8(Sept. 1963).

It has been shown that the vibronic Schrödinger equation for a pair of identical molecules can be solved numerically over the entire range of coupling strengths under the assumption that the only effect of electronic excitation on the molecular vibration is to produce a change in equilibrium internuclear distance without a change in frequency. Preliminary calculations were carried out that illustrate the simple behavior of the energy levels and spectra in the

weak-coupling and strong-coupling limits and the very complicated behavior in the intermediate-coupling region. More extensive calculations are currently under way and will be reported in detail. (auth)

Analytical Procedures

Refer also to abstracts 40471, 40477, and 41239.

40689 (AEET/ANAL/15) SEPARATION OF THE CHLORINATED EARTH ACIDS FROM THE UNREACTED ONES IN FUSED ELECTROLYTIC BATHS AND THEIR INDIVIDUAL DETERMINATION. N. Krishnamachari and Ch. Venkateswarlu (India. Atomic Energy Establishment, Trombay). 1963. 7p.

The chlorinated oxides of niobium and tantalum are separated from the unreacted earth acids by boiling in a mixture of oxalic and hydrochloric acids. The unreacted earth acids remain insoluble whereas the hydrous oxides formed from chlorinated material readily dissolve. The niobium content of each fraction is determined by measuring the absorption of the mixed complex with gallic acid and EDTA in tartrate medium and the tantalum content by difference. (auth)

40690 (CEA-2292) MICRO-ANALYSEUR A SONDE ELECTRONIQUE. METHODE D'ANALYSE D'ECHANTILLONS A BASE DE PLUTONIUM. (Electron-Probe Microanalysis of Plutonium-Base Alloys). M. Dupuy, G. Moreau, and D. Calais (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Fontenay-aux-Roses). 1963. 37p.

The plutonium alloys are prepared according to Scott's method: decontamination, deposition of a formvar film, and introduction in the microprobe. L and M emission spectra are determined by rotating a quartz crystal on the Rowland circle and recording x-ray intensity versus wavelength. A 99 wt % Pu–Al alloy, easier to decontaminate than pure plutonium (slow oxidation), is the standard. Absorption coefficients are calculated by Jonsson's method. (auth)

40691 (CEA-2308) ETUDE D'UN APPAREILLAGE DE MICROSUBLIMATION AVEC ENTRAINEMENT DES VAPEURS PAR POMPAGE ET APPLICATION A L'ANALYSE DES PRODUITS FLUORES. (Study of a Micro-Sublimation Apparatus with Removal of the Vapors by Pumping; Application to the Analysis of Fluorinated Products). P. Delvalle (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 21p.

Microsublimation analysis presents definite advantages both from the qualitative and quantitative points of view. An automatic microsublimation analysis apparatus was developed for the analysis of fluorinated products (ClF_3, HF, UF_6, etc.) but this is only one particular application of a method which has a far wider field of possible applications. The most favorable conditions for the operation of such an apparatus are given. These conditions are the use of a detector which is linear and independent of the nature of the gas, the flow of the sublimed vapors in the conditions of molecular flow, and finally a reproducible and linear re-heating of the separating trap. The apparatus thus built has the advantage of yielding any analysis without prior calibration. It also makes possible the easy identification of an unknown product by the determination of its vapor pressure curve and its molecular weight. The analysis of fluorinated products with this apparatus showed that the experimental results agree well with what is expected. (auth)

40692 (DP-603) IDENTIFICATION OF CURIUM-242 IN IRRADIATED NEPTUNIUM. Glenn A. Carothers (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 1961. Contract AT(07-2)-1. 8p.

Curium-242 was experimentally identified as a minor product of the irradiation of neptunium-237 in a nuclear reactor. (auth)

40693 (DP-748) DETERMINATION OF NEPTUNIUM IN HIGH-ACTIVITY WASTE. H. Perry Holcomb (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1962. Contract AT(07-2)-1. 8p.

An existing ion exchange method was adapted for use in a shielded facility to separate Np^{237} from highly radioactive solutions. The subsequent determination of neptunium was made by alpha counting and alpha pulse height analysis. The coefficient of variation was 4.8% (n =10) for a synthetic sample and 5.9% (n = 23) for plant samples. (auth)

40694 (DP-762) DETERMINATION OF NEPTUNIUM BY EXTRACTION WITH TRI-n-OCTYLAMINE. Robert D. Britt, Jr. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1962. Contract AT(07-2)-1. 10p.

An analytical method was developed for the determination of Np^{237} in solutions that contain plutonium and fission products. Np(IV) was extracted into tri-n-octylamine. A quantitative recovery of a Np^{237} standard was obtained with a coefficient of variation of 1.0% (n = 10). A coefficient of variation of 3% was obtained for seven analyses of a process sample. (auth)

40695 (NLCO-887) QUALITY CONTROL IN THE ANALYTICAL LABORATORY. E. A. Brown (National Lead Co. of Ohio, Cincinnati). Aug. 16, 1963. Contract AT(30-1)-1156. 16p. (CONF-253-3)

From 13th Annual National Lead Company Analytical and Physical Testing Symposium, Hightstown, N. J., Oct. 1963.

Building confidence in the results reported by an analytical laboratory is an important obligation for all laboratory personnel. Such confidence may be achieved through the application of quality control and statistical methods to laboratory data. The quality control program at the National Lead Co. of Ohio is based upon the use of two general types of control samples: control standards and recycle plant samples. The control standards may be either synthetic solutions of known composition or carefully analyzed plant materials. Analysis of the control data is made on a daily basis. The problems relating to the preparation and stability of the control samples are discussed as well as the system used to evaluate the results. An inter-plant quality control program among certain AEC operating contractors is also in operation. This program helps resolve any analytical bias among the AEC sites. Statistical methods are useful also in the study of a number of analytical laboratory problems; examples are given. (auth)

40696 (RT/CHI(63)-12) POLAROGRAPHIC DETERMINATION OF URANIUM(VI) IN NITRIC ACID SOLUTIONS. G. R. Guidotti and S. Margherita (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Mar. 1963. 20p.

The possibility of a polarographic determination of low concentrations of hexavalent uranium in nitric acid medium was investigated. Details are given on a quantitative pro-

cedure which is applicable to amounts of uranium(VI) ranging from 1×10^{-3} to 1×10^{-5} moles/l in the presence of 0.5 to 3.0 molar nitric acid. This method is also applicable in the presence of uranium(IV) nitrate and formic acid. (auth)

40697 (TID-7655) PROCEEDINGS OF THE SIXTH CONFERENCE ON ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY HELD AT GATLINBURG, TENNESSEE, OCTOBER 9–11, 1962. (Oak Ridge National Lab., Tenn.). Contract [W-7405-eng-26].

Thirty papers and 22 abstracts of papers presented at the Sixth Conference on Analytical Chemistry in Nuclear Reactor Technology are included. Separate abstracts were prepared for 25 of the papers. Five papers were previously abstracted for NSA. (M.C.G.)

40698 (TID-7655(p.1-11)) ACTIVATION ANALYSIS WITH A RESEARCH REACTOR—NEW DEVELOPMENTS. Vincent P. Guinn (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

A summary of recent developments in the use of modern research reactors in the field of neutron activation analysis is presented. Research reactors provide neutron fluxes in the range of 10^{11} to 10^{13} nv at costs of only $150,000 to $250,000. With thermal neutron fluxes of about 2×10^{12} nv some 60 elements can be detected down to levels of 5 μg or less, employing a 1-hr irradiation time and gamma detection. Some elements can be detected down to levels as low as 5 pg (5×10^{-12} g). Of these 60 elements, the median sensitivity of detection is 50 ng. This corresponds to 0.05 ppm in a 1-g sample, or 0.005 ppm in a 10-g sample. If elements which form only pure beta emitters are added to the list, an additional six elements are included. If elements appreciably activated only by fast neutrons are added to the list, an additional four elements are included—for a total of 70 elements. The inherent ultrasensitivity of the neutron activation analysis technique, when research reactor fluxes are available, resulted in great emphasis on the use of the method to determine extremely low concentrations of various trace elements (ppm to sub-ppb) in a variety of matrices, and higher concentrations of various elements in extremely small samples (μg to mg). More recently, the value of the technique for routine use in determinations at higher levels, where it competes with standard chemical and spectrographic methods, has gradually become recognized, especially where it can be applied in the rapid, nondestructive, purely instrumental form. Five developments of considerable importance to the utilization of research reactors for activation analysis work are discussed. These are: development of a reactor which can be pulsed reproducibly to neutron fluxes of about 5×10^{16} nv; development of a system of neutron activation analysis based on fast neutron reactions brought about by the high fluxes of fast neutrons which exist in the reactor core; development of an apparatus which allows large numbers of samples to be irradiated at exactly the same neutron flux; development of a purely instrumental technique, based upon gamma spectrometry, which is rapid, nondestructive, and widely applicable; and development of improved data reduction methods, based upon spectrum strippers or upon high-speed, large-memory, electronic computers, to convert the raw gamma-spectrometry data rapidly and accurately to the amounts of the various elements detected in samples. (auth)

40699 (TID-7655(p.40-52)) THE TEXAS A. AND M. MARK I-Ia, AUTOMATIC REACTOR AND COMPUTER-COUPLED SYSTEM FOR ACTIVATION ANALYSIS. L. E. Fite, W. W. Wilkins, and R. E. Wainerdi (Texas. Agricultural and Mechanical Coll., College Station).

The instrumental approach to activation analysis was systematized into a device suitable for automatically processing previously prepared samples through the steps of reactor activation, flux measurement during activation, detection, and storage and data transfer, with the necessary time-of-year information presented in computer oriented format. The system (operating in the Mark Ia mode) selects a sample from the "inactive library," pneumatically transfers it to a reactor activation position for a preset time, punches the time of year at the start of activation, stores the thermal neutron flux level at the site of irradiation every hundredth, tenth, unit, or tens of minutes in the memory of a multichannel analyzer, pneumatically returns the sample to a 3- by 3-in. well crystal detector, prints out the time of the year and the activating flux level history, counts the sample for a preset live time, prints out the live time selected as well as the time of year at the end of counting, pneumatically returns the sample to an "active library," punches out the spectral data and sample identification information, transfers the data to IBM cards, and selects the next sample for analysis, all automatically. The system will process samples in 100-sample lots without attention or external control. A single switch converts the system to operate in the Mark I mode, wherein samples which were previously activated in bulk are manually loaded into the "active library" and thence selected, counted, and returned automatically. Operating in this mode, the system processes 2400 samples in 164 hours. The Mark Ia mode is, of course, less rapid since the samples are individually activated, but in this mode the opportunity is afforded the operator to optimize the activation, waiting, and counting parameters for particular samples. Since all of the time and data formats are oriented towards computer data reduction, the data from the analyzers in either the Mark I or Ia modes are processed by the IBM 709 of the Texas A. and M. Data Processing Center, with the recently developed AA-4 program, in less than 1 minute per sample. (auth)

40700 (TID-7655(p.61-89)) NEUTRON ACTIVATION ANALYSIS OF URANIUM-235 WITH IMPROVED PRECISION AND ACCURACY. H. Bussell, C. L. Zyskowski, and L. C. Nelson, Jr. (New Brunswick Lab., AEC, N. J.).

The method reported previously for the determination of U^{235} by neutron activation was improved by increasing the neutron flux, the scintillation counter sensitivity, and the sample size. Counting rates large enough to attain precision and accuracy of the order of 0.1% U^{235} in the range of 15 to 93% were achieved. A 5-g radium-beryllium neutron source was used to activate the pure uranium sample and a 4-in. NaI(Tl) crystal was used in the scintillation counting assembly. Neutron-induced fission counting rates of 1 to 2×10^6 counts/ min are faithfully reproduced. Stable automatic timers and scalers are used to record the counts. (auth)

40701 (TID-7655(p.90-106)) DETERMINATION OF BERYLLIUM IN BERYLLIUM METAL BY ACTIVATION ANALYSIS. F. W. Postma, Jr. and C. S. McMurray, Jr. (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.).

A method for determining the beryllium content of beryllium metal with a precision of +0.1% limit of error at the 95% confidence level is needed. Preliminary considerations indicated that a method of analysis based on the reactions $Sb^{124} \rightarrow Te^{124} + \beta^- + \gamma(0.6\text{-}1.7\ Mev)$, and $Be^9 +$

$\gamma \rightarrow 2He^4 + n^1$ was feasible because of the low threshold of beryllium (1.63 Mev) and since the next higher threshold, that of deuterium, is 2.2 Mev. Gamma activation appears to offer advantages of speed, specificity, and method simplicity. A previous study was conducted by Burkhart, Moeller, and Whitmarsh by use of a 0.5-c source and beryllium solutions in a pile of lead bricks. Results indicated that the amount of beryllium necessary to obtain the required counting statistics in a reasonable period of time could not be achieved with a saturated aqueous solution. The instrument used in the current study consisted of a pencil-shaped source concentrically surrounded by the beryllium sample, the paraffin moderator, five fission counter tubes, and the lead shield, in that order. Three different types of source geometry were tried, using powdered antimony and antimony rods. A counter with a six-decade capacity and a 1-μsec dead-time was used in conjunction with a six-decade electronic timer having a 0.01-sec start-stop error. Counting times of 180 to 2300 sec were used, depending on the strength of the source, to obtain a minimum of seven million counts for each measurement. Studies were conducted on samples of beryllium machine chips and turnings placed in a cylindrical plastic container which could be lowered concentrically over the source, on machined beryllium cylinders and disks, and on pressed chips and turnings. (auth)

40702 (TID-7655(p.107-18)) RADIONUCLIDES FOUND AT EQUILIBRIUM CONDITIONS IN THE COOLING WATER OF A 5-MEGAWATT POOL-TYPE RESEARCH REACTOR. J. R. Pelrine (Industrial Reactor Labs., Inc., Plainsboro, N. J.).

The primary cooling system of the IRL (Industrial Reactor Laboratories) reactor has a total volume of 160,000 gal of water which passes through the core at the rate of 2500 gpm. This water was analyzed by gamma spectrometry. Several different methods were used for the collection and preparation of samples, depending on the half life of the isotopes. Since Na^{24} comprised more than 90% of the total pool activity, the main problem was associated with the removal of the sodium interference. For some short-lived isotopes, samples were taken from the core exit line during reactor startup. Al^{28} and Mg^{27} had sufficient core production rates to permit direct examination of a small sample of the water in a well-type scintillation crystal. Data obtained were used to calculate the concentration of these isotopes in the pool water. The concentration of short-lived isotopes in the pool water was very low due to the cooling water being delayed 10 min in a holdup tank before its return to the pool. In addition, a 100-gpm, mixed-bed scavenger demineralizer reduced considerably the concentration of all isotopes in the cooling water. The demineralizer was found to be 98% efficient even after four months service between regeneration of the resin beds. Analysis of the regenerant solution was valuable in the identification of many isotopes present in small concentrations in the cooling system, even though no quantitative information could be gained from it. Radiochemical separations procedures were set up for many other isotopes that are present in small amounts. A 3-liter sample of cooling water is processed weekly and counted for gross beta-gamma and alpha activity after one-week, one-month, and six-month decay intervals. Decay curves were drawn for these samples and gamma spectral analyses were made thereon. Samples of this type taken over the past year showed a steadily increasing buildup of long-lived fission products such as $Zr^{95}-Nb^{95}$ and $Ba^{140}-La^{140}$ in the cooling system. A scintillation crystal was placed at a side stream off the core exit line. Gamma spectra were recorded at various time intervals and power levels during reactor startups. Since the IRL reactor is normally started and shut down each week, it was possible to repeat this experiment many times. Results of this work are summarized. (auth)

40703 (TID-7655(p.119-34)) A MODIFIED X-RAY DIFFRACTOMETER FOR MEDIUM-LEVEL RADIOACTIVE SAMPLES. W. A. Ryder, G. V. Wheeler (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho), H. H. Leigh, and Fred W. Schultz (General Electric Co., Salt Lake City).

An x-ray diffractometer for the examination of medium-level, radioactive samples is described. This instrument which uses direct optics rather than reverse optics, makes use of a curved crystal monochromator between the sample and the detector and a moving concentric lead shield arrangement to provide 2 in. of biological and 5 in. of detector shielding from the sample radiation. This arrangement provided the required shielding for the anticipated samples with a minimum of cost and of instrument modification. The instrument can be converted for conventional operation in about 1 hr. The actual design, operating characteristics, comparison of intensities for conventional and shielded operation with standard and high intensity x-ray tubes, and capabilities with radioactive samples are discussed. (auth)

40704 (TID-7655(p.135-46)) A MICROSCOPE FOR ULTRAHIGH TEMPERATURES. D. M. Olson (Los Alamos Scientific Lab., N. Mex.).

For the past half century it was generally assumed that high temperature microscopy is limited to the general region of 900 to 1100°C. By abandoning refraction optics and working with a concave ellipsoidal mirror as an objective, a microscope was designed and built, with which specimens can be examined and photographed at 30 to 600× in a vacuum or controlled atmosphere, at any temperature, from ambient to about 4500°F (2500°C). Several phase transformations at high temperatures were seen and photographed. Modifications, which employ lateral illumination, made possible the examination of specimens having relatively great surface relief such as powder metallurgy products, ceramics, and chemical compounds. (auth)

40705 (TID-7655(p.147-175)) AN IN-LINE INSTRUMENT FOR THE RAPID AUTOMATIC DETERMINATION OF GAS CONCENTRATIONS IN OUT-OF-PILE SIMULATED BOILING WATER REACTOR AND SUPERHEATED STEAM LOOPS. M. Siegler and D. T. Snyder (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.).

Analytical equipment is described, which was conceived and developed to meet the increasing demands for the precise environmental monitoring and control needed for material testing in out-of-pile simulated boiling water reactor and superheated steam loops. The equipment is operated as an in-line analyzer for several corrosion loop facilities. The sample lines from these facilities are directly connected to the analyzer by means of valving manifolds. The three primary gases of interest are hydrogen, oxygen, and nitrogen. These gases, which are present in both the free and dissolved gas forms, can be determined within the following limits, at the rate of four to six water or condensed steam samples per hour: H_2, 0.0002 to 13 ppm; O_2, 0.03 to 2000 ppm; and N_2, 0.04 to 2500 ppm. A water sample is drawn into the stripper bulb to purge the sample line. This water sample is then expelled to waste. The previous gas sample is cleared from the stripper loop by an alternate pressurization and venting

procedure, by use of argon gas. A measured volume of water is drawn into the stripper bulb. The dissolved gases are stripped from the sample by recirculating the argon gas through the closed stripper loop by means of a diaphragm pump. An aliquot portion of the equilibrated gas phase is injected into the gas chromatograph by means of a multiport sample valve common to both systems. Two 100,000-ohm thermistors form the sensing elements of the thermal conductivity bridge. The sample results are recorded on a two-pen potentiometric strip chart recorder, which simultaneously displays both the peak height and peak area. A number of electronic and mechanical devices were specifically developed in order to provide a completely automatic analytical system. The automatic features of the system assure standard repeatable operating conditions. The special devices are used in conjunction with several time-based programmers as well as a step programmer to provide the overall automatic cycle. Analytical time was reduced from a previous 30 min per sample to 10 or 15 min per sample. (auth)

40706 (TID-7655(p.181-8)) DETERMINATION OF DIBUTYLPHOSPHATE IN TRIBUTYLPHOSPHATE–KEROSENE SOLUTIONS—AN ALUMINA-COLUMN SEPARATION PROCEDURE. Marven A. Wade and Stanley S. Yamamura (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

The selective adsorption of the univalent dibutylphosphate (DBP) anion on an alumina column followed by elution and spectrophotometric measurement as inorganic phosphate is the basis for the determination of DBP in tributylphosphate-kerosene solutions. Uncharged tributylphosphate (TBP) is not adsorbed. Inorganic phosphate, though adsorbed, is separated from DBP by chromatographic elution. A column of anionotropic alumina is converted to the perchlorate form by successive washings with NH_4OH, $HClO_4$, and water. Because of the immiscibility of kerosene and water, water is removed from the column with acetone rinsings. The kerosene sample is passed directly through the column at a rate of 5 ml/min. Alternatively, the DBP fraction is extracted from the kerosene sample into dilute NaOH, then acidified and passed through the column. Dibutylphosphate and inorganic phosphate are quantitatively retained on the alumina. Kerosene and TBP which are not adsorbed are washed through the column with acetone. The DBP is eluted with dilute NH_4OH. The ammoniacal DBP fraction is boiled to expel the ammonia, and then digested with 5 ml of $HClO_4$. The resulting orthophosphate is extracted as the phosphomolybdic acid complex into methyl isobutyl ketone and determined spectrophotometrically at 625 mμ in 1-cm cells after reduction to molybdenum blue with $SnCl_2$. The range of the method is 0.2 to 1 μmole of DBP. For simulated kerosene samples of the composition 1.35×10^{-1} M TBP, 1×10^{-4} M uranyl nitrate, and 22.1 to 110.7 μg DBP, the average recovery of DBP was 100.6% with a relative standard deviation of ±2%. (auth)

40707 (TID-7655(p.193-211)) APPLICATION OF THE COPPER-SPARK METHOD FOR SPECTROGRAPHIC ANALYSIS. J. P. Faris (Argonne National Lab., Ill.).

The copper-spark method of analysis filled the need for a reliable and uncomplicated procedure to complement conventional d-c arc techniques for routine examination of many different types of materials. Some 65 elements can be readily determined by visually comparing a sample spectrum with spectra of stock standard plates. By limiting the weight of material deposited on the electrodes to about 50 μg, interelement effects are minimized and an accuracy of about ±40% is obtained. The spectroscopic techniques used in the development of analytical methods and some specific applications are discussed, as well as the limitations and possible sources of error. (auth)

40708 (TID-7655(p.217-39)) SOME ASPECTS OF THE MEASUREMENT OF THE OXYGEN-TO-METAL RATIO IN SOLID SOLUTIONS OF URANIUM AND PLUTONIUM DIOXIDES. J. L. Drummond and V. M. Sinclair (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland).

Oxide type fuels containing both uranium and plutonium were proposed as fuels for fast reactor systems. A study is being made of the use of solid solutions of plutonium and uranium dioxides in such a system. In the investigations, which are being made into the manufacture and behavior of these fuels, one of the factors which is of prime interest is the oxygen-to-metal ratio of the solid solution. In the uranium dioxide-plutonium dioxide system a continuous solid solution is formed which has a fluorite type lattice and is isostructural with both of the dioxide compounds. This solid solution can contain either an excess or a deficiency of oxygen and thus depart from the overall stoichiometry of an oxygen-to-metal atomic ratio of 2.000 while still remaining a single-phase system exhibiting a cubic structure. Methods of measuring the stoichiometry of the solid solution which were investigated include: the measurement of the carbon dioxide formed on the reduction of the super stoichiometric oxide to MO_2 with carbon monoxide, the gravimetric determination of the composition of the uranium-plutonium dioxide by ignition, in air, to a known composition, the use of hydrogen and oxygen redox cycles on a thermobalance, and the use of x-ray diffraction techniques. Work on the reduction of the superstoichiometric solid solution with carbon monoxide failed to yield a satisfactory analytical method for determining the excess oxygen. Studies of the oxidized solid solution of plutonium-uranium dioxide showed that it is extremely difficult to control and reproduce the oxygen-to-metal ratio of the oxidized product. Thermogravimetric studies were made on the solid solution and these resulted in a method which can be applied to both super- and substoichiometric samples. The precision of this method corresponds to a standard deviation of 0.0014 in the oxygen-to-metal ratio. Data are presented on the thermogravimetric studies and on the method. Variations in the cell parameter of the solid solution of the dioxides with the plutonium-to-uranium ratio and also the oxygen-to-metal ratio were measured by x-ray diffraction techniques and these data are presented. The use of cell parameter measurements for stoichiometry determinations was considered and its limitations are discussed. (auth)

40709 (TID-7655(p.240-6)) DIRECT VOLUMETRIC DETERMINATION OF URANIUM AND PLUTONIUM IN NITRIC ACID MEDIUM. J. Corpel and F. Regnaud (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Fontenay-aux-Roses).

A method is described for the titrimetric determination of uranium and plutonium in HNO_3 medium. Precautions normally taken in this medium are unnecessary. The element is reduced with titanium(III) solution in the presence of sulfamic acid and titrated with cerium(IV) solution. The method is rapid and accurate and especially useful in glove boxes or shielded cells for the determination of plutonium and irradiated uranium. (auth)

40710 (TID-7655(p.275-84)) THE DETERMINATION OF CESIUM-137 IN SOLUTIONS OR IRRADIATED UO_2 FUEL USING PRE-FORMED AMMONIUM MOLYBDOPHOSPHATE. G. M. Allison, R. A. Ferguson, and C. McLaughlin (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.).

The property of ammonium molybdophosphate (AMP) to remove cesium quantitatively from acid solution was used to separate Cs^{137} from solutions of irradiated UO_2 fuel. In this method, the acid solution of UO_2 is passed through a layer of preformed AMP in a filter tower. Interference from Zr^{95} is eliminated by complexing it with fluoride which prevents its retention by the AMP. Results obtained with this method were compared with those from a standard radiochemical procedure and the agreement was better than ±5%. In all cases, counting was done with a 3- by 3-in. NaI(Tl) scintillation crystal and 100-channel pulse-height analyzer. (auth)

40711 (TID-7655(p.291-301)) THE APPLICATION OF ONE-STEP RADIOMETRIC TITRATION TO THE ANALYSIS OF ALUMINUM-CONTAINING SILICATES. D. S. Berry and B. F. Scott (Nuclear-Chicago Corp., Des Plaines, Ill.).

A method is presented for determining SiO_2 in cement and cement raw materials. The analysis is based on a one-step radiometric titration of fluoride, by use of the techniques of radiometric chemical analysis previously reported. Silica is separated as K_2SiF_6. Ca^{45} and Ce^{144}-Pr^{144} are compared as radioreagents for the determination of fluoride. The use of a thin-wall, beta-counter centrifuge is compared to a dip-tube counter with respect to accuracy and convenience. The determination of silicon in the insoluble potassium fluosilicate was previously described. The authors reported interference from aluminum and titanium. This prevents the method from being used in the analysis of cement and other aluminum-containing materials. The determination of fluosilicate by titration with base is subject to interference from metal elements which form insoluble hydroxides. This interference is avoided by titrating the released fluoride with radioreagents. Fluoride is released from the fluosilicate precipitate by digesting at pH 10 to 11. It is titrated with a small excess of either $Ca^{45}(Cl_2)_2$ or Ce^{144}-$Pr^{144}(NO_3)_3$. The excess titrant is determined radiometrically, by use of either a beta-detector centrifuge or a beta detector designed for dipping into liquids. By the use of $Ca^{45}Cl_2$ as a radioreagent, a rapid-forming precipitate is produced which can be processed immediately. Precautions are necessary to prevent the formation of $Ca^{45}CO_3$ on the surface of the counting sample. Accuracies of a few percent are obtained. The use of Ce^{144}-Pr^{144} permits the less-costly dipping detector to be employed, but has the disadvantage of a slow-forming precipitate. (auth)

40712 (TID-7655(p.302-11)) APPLICATIONS OF RADIOISOTOPES IN POLAROGRAPHY. Ward B. Schaap and Emil Wildman (Indiana. Univ., Bloomington).

A procedure was devised whereby accurate activity-voltage curves may be derived from measurements on a solution containing a radioactive isotope of an element, an ionic or molecular species of which is reduced to form an amalgam at the dropping mercury electrode. The activity appearing in the amalgam parallels the polarographic current. If sufficient precautions are taken, the shape of the activity vs voltage curve corresponds to theory, that is, a plot of log $(a_d - a)$ vs E_{de} (a is activity) is linear with a slope of RT/nF. The method was tested with reversibly reduced thallous ion containing Tl^{204}, a beta emitter. The presence of CCl_4, used by Love in similar experiments to allow the collected mercury to be separated from the active solution, was found to produce erratic results in this case. Accordingly, a cell was designed that eliminates the need for a heavy organic solvent by utilizing "locks" to isolate the active solution. The cell also has provisions for automatic, counter-current washing of the mercury amalgam. The drops are collected for measured periods of time at a series of voltages. The mercury may be counted directly or leached, dissolved, or evaporated before the activity is counted. The experiments utilizing Tl^{204}, which was not carrier free, were carried out at total concentrations of thallium ranging from 10^{-4} to 10^{-8} M. At the lower concentrations, the diffusion region of the curve was not flat, but rose sharply with increasingly negative applied potential. This rise could be eliminated by addition of excess inactive thallium or other more easily reducible ionic species, such as Cu^{2+}. These experiments indicated that the capacitive charge on the mercury drops, which increases past the electrocapillary maximum, is removed by faradaic processes, such as the reduction of thallium or copper, as the drops fall through the solution. Only when the total concentration of the reducible ions is very low and the specific activity of the radioisotope is high does the relative effect of capacitive charge become important. Applications of "radio-polarography" are based on the qualitative or quantitative determination of isotopes which can be reduced to the metallic state (preferably amalgams) within the polarographic range. In radiochemistry, detection of certain isotopes following bombardment is possible. Direct measurement of specific activity of these isotopes is also possible if both the conventional polarographic diffusion current and the activity are measured. The activity of a particular species during a radiochemical exchange reaction may, in some cases, be followed without introducing appreciable concentration changes. In polarography, applications of this technique include fundamental studies at very low electrolyte concentrations where solute ideality is approached, even in nonaqueous solvents (calculations indicate that it should be possible to obtain radio-polarograms with concentrations as low as 10^{-16} M for carrier-free isotopes of short half life), measurement of $E_{\frac{1}{2}}$ values of ions that are obscured by other electrode processes or by high residual currents in conventional polarography, and investigation of anomalous polarographic currents and electrode processes. (auth)

40713 (TID-7655(p.312-20)) USE OF RADIOISOTOPES IN THE DETERMINATION OF DISTRIBUTION COEFFICIENTS OF ALKALI METALS IN AN ORGANIC PHOSPHATE-AQUEOUS SYSTEM. Robert J. Klett and Bert Wilkins, Jr. (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station).

The separation of the Group II metal, strontium, barium, and calcium, by solvent extraction into di-2-ethylhexyl phosphoric acid (D2EHPA) in Amsco 125-82 diluent as the organic, low-density phase, is complicated by competition from sodium for exchange sites in the organic phase. Sodium is inherent in the system since the feed material is highly acidic and is neutralized with caustic prior to the solvent extraction operation. Because of the presence of four extractable species in addition to the hydrogen ion many analytical determinations are required in order to describe the behavior of this system under one set of conditions. To determine the distribution coefficients, which range as low as 10^{-3} to 10^{-4}, by means of a radioactive tracer, it is necessary to have a fairly high level of ra-

dioactivity in the system. To eliminate the necessity of handling this level of activity and to arrive at a system which can be critically adjusted with respect to pH and salt concentration, a semibatch type contactor with closed-cycle sample loops was developed. A complete description of this equipment and a summary of the analytical procedures used in data collection are presented. The experimental equipment consists of three main parts: the contact vessel, the sample loops, and the counting equipment. This contact flask is equipped with exit ports which are located in such a manner as to provide simple access to each phase for sampling purposes. These ports make it possible to withdraw samples of each phase contained in the vessel, thus avoiding the necessity of excessive physical manipulation of the radioactive solutions. The sample solutions are returned to the contact vessel through a closed loop after pH and phase activity determinations were made. This provides a simple, sensitive, and safe method for the determination of phase activity. The equipment was designed for a semibatch type operation. The system under study is allowed to equilibrate, after which the pH of the aqueous phase and the activity of the radioactive species in each phase is determined. Equilibrium is then disturbed by addition of acid to the system, the system is then again allowed to come to equilibrium, and the pH and phase activity are again determined. With this method it is possible to determine the distribution coefficient of the system for varying values of pH while the other ions under consideration are maintained at fixed concentrations. (auth)

40714 (TID-7655(p.321-9)) DETERMINATION OF PHOSPHORUS IN URANIUM BY ISOTOPE DILUTION ANALYSIS. Fausto W. Lima and Laura T. Atalla (Brazil. Instituto de Energie Atomica, Sao Paulo).

Phosphorus at the level of ppm in uranium compounds is usually determined by optical spectrography or by colorimetric methods. Chemical methods, such as precipitation of ammonium phosphomolybdate, formation of magnesium pyrophosphate, and titration of ammonium phosphomolybdate with sodium hydroxide, when applied to the samples mentioned in this paper, gave results below the actual amount of phosphorus present. Lower values than the actual ones indicated a loss of phosphorus during the analysis. It was believed that by tagging the phosphorus in the sample with P^{32}, the method of isotope dilution might be applied, by the use of one of the chemical procedures mentioned above, since the isotope dilution procedure takes into account the loss of the element being analyzed. In order to check the method before applying it to the uranium samples, solutions of disodium phosphate were prepared containing increasing amounts of phosphorus ranging from 0.04 to 1.5 mg. The results were found to be in agreement within 10% of the amount of phosphorus present for solutions with high concentrations of phosphorus. The method was subsequently applied to samples of ammonium diuranate, which were analyzed spectrographically and also colorimetrically. The results are in agreement, within 2 to 5%. Tables are presented of the results for samples of uranium as well as for the disodium phosphate solutions. A complete analysis takes about 5 hr. (auth)

40715 (TID-7655(p.333-78)) ATOMIC-ABSORPTION SPECTROSCOPY: A REVIEW OF RECENT DEVELOPMENTS. Paul T. Gilbert, Jr. (Beckman Instruments, Inc., Fullerton, Calif.).

Advances in analytical atomic-absorption spectroscopy are discussed. Topics covered include: terminology, absorption and emission flame photometry, atomic-absorption spectroscopy without flames, instrumentation for absorption flame photometry, analytical characteristics, the individual elements, and materials analyzed. One hundred and sixty-three references are included. (M.C.G.)

40716 (TID-7655(p.379-89)) AN ATOMIC-ABSORPTION TUBE FOR USE WITH AN ATOMIZER-BURNER: APPLICATION TO THE DETERMINATION OF MERCURY. Cyrus Feldman and Ramachandra K. Dhumwad (Oak Ridge National Lab., Tenn.).

An atomic-absorption method is described for the determination of mercury in which the sample solution is aspirated into the flame of an atomizer-burner. The solution is fed into a hole at the center of an air-cooled stainless steel tube, 0.5- by 10-in., oriented along the optic axis of a monochromator. Light (2537 Å) from a low-pressure mercury lamp is chapped and passed through the tube and into a monochromator and the detector system. Detection sensitivities for mercury (defined as the concentration giving a mean deflection equal to twice the noise level) are 0.5 μg/ml in aqueous solution and 0.2 μg/ml in methyl isobutyl ketone. The presence of 100 μg/ml of a foreign metal element caused little or no change in the degree of absorption caused by 1 or 10 μg/ml of mercury. Several metals usually extracted by dithizone caused no interference with a solution of dithizone in methyl isobutyl ketone was used as the extractant and aspirated directly. The apparatus also proved effective in determining nickel and cadmium. The determination of other elements by this method is under investigation. (auth)

40717 (TID-7655(p.390-9)) LITHIUM ISOTOPE ANALYSIS BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY. D. C. Manning and Walter Slavin (Perkin-Elmer Corp., Norwalk, Conn.).

A method is described utilizing atomic-absorption spectrophotometry for the determination of the isotope ratio of Li^6 and Li^7. The technique is very rapid and relatively simple spectrophotometric instrumentation is utilized. There is little trouble from the interference of other metal species, so that it is not necessary to separate the lithium prior to analysis. The measurements may be made over a wide range of total lithium in the sample. The potentiality of the atomic-absorption method for other isotopic analyses is also discussed. (auth)

40718 (TID-7655(p.400-13)) A GRATING MONOCHROMATOR. Wilbur Kaye (Beckman Instruments, Inc., Fullerton, Calif.).

Replacement of the prism in the Beckman DU and DK monochromators by a grating resulted in increased dispersion in the near ultraviolet and visible regions. This increased dispersion was particularly useful in flame photometry and fluorescence spectroscopy. A grating with 1200 lines per mm blazed at 5000 Å was used in the first and second orders. Filters were used to sort orders. The limiting observable resolution was 0.2 Å. Most Du and DK accessories can be accommodated on this monochromator, which was custom designed. (auth)

40719 (TID-7655(p.414-29)) ANALYTICAL TECHNIQUES USED IN EVALUATING HIGH-TEMPERATURE PHASE EQUILIBRIA: APPLICATION TO THE UO_2–ThO_2–O_2 SYSTEM. H. A. Friedman (Oak Ridge National Lab., Tenn.).

By employing several complementary techniques, one may accurately determine high-temperature solid state transitions in binary and ternary oxide systems. Required

analytical data are best obtained from examinations with x-ray diffraction equipment, the metallograph, and the polarizing-light microscope as well as the electron-probe analyzer and the electron microscope. High-temperature transitions in the system, $ThO_2-UO_2-O_2$, were established by the results of examinations, which were made by utilizing these analytical instruments. A description of the pressure-temperature-composition relationships limiting the fluorite cubic phase, ThO_2-UO_{2+x}, depends on the detection of small amounts of second phases formed by the decomposition of the ThO_2-UO_{2+x} phase. The secondary phases, when present in sufficient quantity, may be identified by the use of the x-ray diffraction equipment. These phases, once identified, can be traced past the limit of detection of the x-ray by the metallograph and by the petrographic microscope (on transparent material). Evaluations of the utility of each of the analytical methods described, including the electron probe analyzer and the electron microscope, for the detection of secondary phases are discussed. (auth)

40720 (TID-7655(p.451-64)) DETERMINATION OF FREE ACIDS IN ORGANIC SOLUTIONS OF TRILAURYLAMINE NITRATE. A. Chesne and G. Koehly (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses).

It is known that, during the course of purification of elements such as plutonium(IV) by solvent extraction with trilaurylamine (TLA), some HNO_3 is extracted into the organic phase. The determination of this "free acid" is of great importance when the stripping of this organic solvent is done with H_2SO_4. The method that is proposed can be used when several cations such as Pu^{4+}, Th^{4+}, Np^{4+}, and UO_2^{2+} are present in the organic phase. The determination is based on: a selective and quantitative stripping of the free HNO_3 by an acid-deficient aqueous solution of $Al(NO_3)_3$ of known "basicity," and a back titration of the acid deficiency of the resulting aqueous phase. The difference in acidity of the aqueous phase before and after equilibration is a measure of the free acid contained in the organic phase. The acid deficiency is established in the following manner. An aliquot of the acid-deficient solution of $Al(NO_3)_3$ is made acidic by addition of a known volume of acid, after which the solution is back titrated with NaOH with oxalic ion present. A potentiometric recorder is used in this titration. The effect of cations, which are present in the organic phase, was studied. Possibilities of extensions of this method are considered, especially those which concern the determination of bisulfate in case the organic solvent is used for extraction of sulfate media. The accuracy depends on the order of magnitude of the free acid to be determined. (auth)

40721 (TID-7655(p.465-72)) BERYLLIUM DETERMINATION AS $Be_2P_2O_7$. C. E. L. Bamberger and J. L. Huguet (Argentina. Comision Nacional de Energia Atomica, Buenos Aires).

One of the most suitable gravimetric methods for beryllium entails the precipitation of beryllium ammonium phosphate in the presence of a masking agent and subsequent ignition of the precipitate to beryllium pyrophosphate prior to weighing. Advantages of this method include: a high gravimetric factor; high selectivity when using Versene as a complexing agent; and freedom from phosphate interference. Many authors report positive errors with this method due to nonstoichiometry of the $Be_2P_2O_7$ and agree that precipitation conditions greatly affect the results. A study was undertaken to examine the effect of different variables on this determination. The precipitation of beryllium with $NH_4H_2PO_4$ was studied in ammonium acetate-acetic acid buffered solutions containing disodium EDTA. Several variables (pH, precipitant concentration, and content of EDTA and NH_4Cl) were examined to determine their effects on: beryllium recovery, solubility of $BeNH_4PO_4$, P_2O_5/BeO ratio in the ignition product ($Be_2P_2O_7$), sodium content of final product, and digestion time required for the transformation of gelatinous $BeNH_4PO_4$ to a granular product. Be^7 tracer, prepared by irradiating lithium in a symchrocyclotron and isolated free of carrier, was used in measuring beryllium phosphate solubility and beryllium losses. The ratio, P_2O_5/BeO, was calculated by use of the following equation: $P_2O_5/BeO = [(A-B)/M_1]/(B/M_2)$ where A = mass of $Be_2P_2O_7$ obtained, B = mass of BeO in the $Be_2P_2O_7$ (total BeO added less BeO lost), and M_1, M_2 = formula weights of P_2O_5 and BeO, respectively. It was found that: 50 g/liter of NH_4Cl decreased the $BeNH_4PO_4$ solubility losses from about 2.3 to 0.8%; when 25 to 30 mg of BeO was precipitated from 200 ml of a solution buffered at pH 5.5, which contained 50 g of NH_4Cl and 3.75 g of Na_2EDTA per liter, the increase in solubility due to the masking agent caused a loss of 0.44 ± 0.04% of the beryllium and the precipitate contained less than 0.1% of sodium; $NH_4H_2PO_4$ concentration was one of the most important factors affecting the precipitation (increasing the $NH_4H_2PO_4$ concentration from 1.6 to 4.4 g/liter decreased the digestion time from 3 or 4 to 1 or 2 hr, reduced the solubility of $BeNH_4PO_4$ from 0.83 to 0.38%, and increased the P_2O_5/BeO molar ratio from 0.502 to 0.519 and the apparent beryllium recovery from about 99.2 to 102%); in the range 5 to 7, pH changes had only small effects upon beryllium recovery, the P_2O_5/BeO ratio, and solubility of the precipitate; and the digestion time necessary to produce a granular, easily filtered precipitate also depended on the point at which $NH_4H_2PO_4$ was added. When the reagent was added after the pH adjustment, the digestion time was shortened. (auth)

40722 (TID-7655(p.473-80)) DISSOLUTION OF IRRADIATED HIGH-FIRED, REFRACTORY NUCLEAR MATERIALS. H. Kubota and R. F. Apple (Oak Ridge National Lab., Tenn.).

Procedures are described, which were devised for the dissolution of a number of refractory, highly radioactive, nuclear fuels and materials in preparation for their subsequent analysis for the purpose of determining burnup, fission products, or nuclear reaction products. Materials for which satisfactory methods of dissolution were found include: thorium oxide, beryllium oxide, thorium-beryllium-uranium oxides, uranium carbide, and strontium titanate. Because of the high radioactivity associated with these materials, the initial sample preparation and dissolution must be performed in hot cells, a requirement that imposes certain restrictions and limitations upon the method to be used. A further difficulty in the analyses of materials of this type stems from the fact that the radioactive materials are, in general, more refractory than "cold" or nonradioactive samples, which are chemically nearly identical. Consequently, procedures that are completely satisfactory with the "cold" sample can be of little or no value when applied to the analysis of actual "hot" samples of similar composition. Also, it is desirable that a medium be selected for dissolution of the sample, which will cause minimum difficulties in the analytical procedure utilized. (auth)

40723 FABRICATION AND USE OF PYROLYTIC GRAPHITE ELECTRODE FOR VOLTAMMETRY IN

AQUEOUS SOLUTIONS. F. J. Miller and H. E. Zittel (Oak Ridge National Lab., Tenn.). Anal. Chem., 35: 1866-9(Nov. 1963).

A pyrolytic graphite indicating electrode was fabricated and applied to voltammetry in aqueous solutions. In either acid chloride or acid nitrate medium, it has a useful range of potential from +1.0 to −0.8 volt vs SCE. Reducible ions that have decomposition potentials in this range can be determined. No treatment of the electrode other than a preliminary cleaning is required prior to or during its use. The following ions were determined at the 10^{-3}M concentration level: Ag(I), Hg(I), Cu(II), UO_2(II), Fe(III), and Sn(IV). The $E_{\frac{1}{4}}$ and i_d/C values are reproducible. The precision obtained in measurements of the various ions is comparable with that of polarography. The voltammetric curves recorded at a scan rate of 0.1 volt/minute are characterized by a definite plateau rather than a peak. A reliable and rugged electrode of any reasonable area can be prepared by the technique described. (auth)

40724 SPECTROPHOTOMETRIC DETERMINATION OF CERIUM WITH THENOYLTRIFLUOROACETONE. Hiroshi Onishi and Charles V. Banks (Ames Lab., Ames, Iowa). Anal. Chem., 35: 1887-9(Nov. 1963). (IS-646)

A spectrophotometric method for the determination of microgram amounts of cerium with thenoyltrifluoroacetone (TTA) is described. After oxidation with sodium bromate, cerium(IV) is extracted with 0.5M TTA in xylene from a 1N sulfuric acid solution. The absorbance of the organic phase is measured at 440 mμ or 450 mμ. Beer's law is followed with good precision up to 10 μg of cerium per ml of organic phase. The absorbance of the extract does not change for 3 hours. Small amounts of aluminum, copper, rare earths, scandium, thorium, uranium, and zirconium do not interfere. Iron(III) gives a color. (auth)

40725 DETERMINATION OF IRON WITH DIETHYLACETIC ACID BY ISOTOPE DILUTION ANALYSIS. Inara Mencis and Thomas R. Sweet (Ohio State Univ., Columbus). Anal. Chem., 35: 1904-7(Nov. 1963).

Solvent extraction, isotope dilution, and spectrophotometry were combined to determine small amounts of iron in the presence of copper. Diethylacetic acid is used as the reagent and solvent for the formation and extraction of the iron complex. Fe^{59} is used as the radioactive tracer. (auth)

40726 DETERMINATION OF HYDROGEN IN SODIUM BY ISOTOPIC DILUTION WITH TRITIUM. Clayton Evans and John Herrington (United Kingdom Atomic Energy Authority, Aldermaston, Berks, Eng.). Anal. Chem., 35: 1907-10(Nov. 1963).

Isotopic dilution with tritium is an efficient method for determining hydrogen in sodium. Satisfactory recoveries were obtained using hydrogen spikes of 16 to 90 μl, corresponding to 140 to 4000 ppm of hydrogen in sodium. The recovery is shown to be independent of concentration. Equilibrium between the added tritiated-hydrogen and the hydrogen in the sample was established by heating in a sealed borosilicate glass tube at 420°C for 10 minutes. The activity of the tritiated hydrogen samples was determined by Geiger counting. (auth)

40727 ATOMIC ABSORPTION SPECTRA OF EUROPIUM, THULIUM, AND YTTERBIUM USING A FLAME AS LINE SOURCE. R. K. Skogerboe and R. A. Woodriff (Montana State Coll., Bozeman). Anal. Chem., 35: 1977 (Nov. 1963).

Experiments showed that atomic absorption spectra of analytical utility can be observed for Eu, Tm, and Yb using the flame as the line source. The four possible combinations of oxyacetylene and oxyhydrogen flames, as source and absorbing flames, were investigated to ascertain which gave the greatest absorption sensitivity. For oxyhydrogen flames, a nearly stoichiometric oxygen and fuel mixture was found to maximize both emission and absorption but extremely fuel-rich oxyacetylene flames were required to observe optimum emission and absorption. Preliminary investigations showed that sodium and calcium can easily be determined at concentrations less than 5 and 20 ppm, respectively. (P.C.H.)

40728 URANIUM ISOTOPE INVESTIGATIONS BY ATOMIC ABSORPTION. Joseph A. Goleb (Argonne National Lab., Ill.). Anal. Chem., 35: 1978(Nov. 1963).

Description is given of a sputtering technique using a hollow-cathode discharge tube as the absorption tube for the determination of uranium and uranium isotopic ratios. Both the absorption and emission tubes were temperature controlled (water-cooled) to reduce spectral line widths. Reproducible sputtering was observed in each tube and stability for atomic absorption measurements was obtained. An enriched cylindrical insert, 93% U^{235} and 7.0% U^{238}, in the absorption tube and the same samples in the emission tube showed very strong absorption for U^{235} and weak absorption for U^{238}. (P.C.H.)

40729 LIQUID SCINTILLATION COUNTING OF BIOLOGICAL COMPOUNDS IN AQUEOUS SOLUTION. Hajime Takahashi, Toshie Hattori, and Bunji Maruo (Tokyo Univ.). Anal. Chem., 35: 1982-3(Nov. 1963).

Hyamine hydroxide in a dioxane-naphthalene-water system was found to hold relatively large amounts of biological materials and to give a high counting efficiency for liquid scintillation. The counting efficiencies of H^3-leucine by toluene-hyamine and by hyamine-water-dioxane systems were compared. The counting efficiencies were found to be comparable. However, sample preparation was much easier and faster with the hyamine-water-dioxane system. The counting efficiencies of H^3-toluene in the presence of various biological compounds are tabulated. (P.C.H.)

40730 ADAPTATION OF A GAS CHROMATOGRAPH FOR ANALYSIS OF RADIOACTIVE GAS SAMPLES. A. D. Horton, A. S. Meyer, Jr., and J. L. Botts (Oak Ridge National Lab., Tenn.). Anal. Chem., 35: 1988-9(Nov. 1963).

A compact four-column gas chromatographic assembly, which operates by remote control was constructed for the analysis of radioactive gas samples. The assembly was designed specifically for the analysis of the hydrolysis products of neutron irradiated thorium and uranium carbides. Operation of any column in the assembly requires the positioning of only two valves and one selector switch. (P.C.H.)

40731 GLASS FILTER PAPER SUSPENSION OF PRECIPITATES FOR LIQUID SCINTILLATION COUNTING. Donald R. Johnson and John Ward Smith (Bureau of Mines, Laramie, Wyo.). Anal. Chem., 35: 1991-2(Nov. 1963).

Glass filter paper suspension of radioactive precipitates was found to provide a simple, direct preparation method for scintillation counting. The technique minimizes problems stemming from tedious precipitate handling and promotes high counting efficiencies. It yields satisfactory assays on samples of low specific activity where hyamine absorption fails. Suspensions of $BaS^{35}O_4$ and $BaC^{14}O_3$ were successfully prepared and counted by the method. (P.C.H.)

40732 AUTORADIOGRAPHY OF TRITIUM-CONTAINING THIN LAYER CHROMATOGRAMS. Herbert Sheppard and Wen Hui Tsien (CIBA Pharmaceutical Co., Summit, N. J.). Anal. Chem., 35: 1992(Nov. 1963).

A simple and sensitive method of preparing autoradiograms from thin layer chromatograms containing tritium-labeled substances was developed. The chromatograms are exposed to photographic plates prepared with nuclear track emulsion. Using this method, as little as 0.01 μC of H^3 is detectable in a compact spot. (P.C.H.)

40733 SPECTROCHEMICAL ANALYSIS OF NUCLEAR GRAPHITE BY DIRECT READING. M. Roca Adell, E. Becerro Ruiz, and F. Alvarez Gonzalez (Junta de Energia Nuclear, Madrid). Anales Real Soc. Esp. Fis. Quim. (Madrid), Ser. B, 59: 335-44(May 1963). (In Spanish)

A description is given of the application of a direct-reading spectrometer, the Quantometer, to the determination of boron, calcium, iron, titanium, and vanadium in nuclear-grade graphite. For boron, the powdered sample is mixed with 1% cupric fluoride and excited in a 10-amp d-c arc and graphite electrodes with a crater 7-mm wide and 10-mm deep. For the other elements, a smaller crater was used, and dilution with a number of matrices was investigated; the best results were achieved by using 25% cupric fluoride. The sensitivity limit for boron was 0.15 ppm. (auth)

40734 SPECTROCHEMICAL ANALYSIS OF MAGNESIUM ALLOYS BY DIRECT READING. M. Roca Adell (Junta de Energia Nuclear, Madrid). Anales Real Soc. Esp. Fis. Quim. (Madrid), Ser. B, 59: 345-50(May 1963). (In Spanish)

A Quantometer was used to determine aluminum, beryllium, calcium, iron, silicon, and zinc in Magnox alloys, after the conversion of the samples to the oxide. For the aluminum, whose concentration was relatively high, the conducting briquet technique with an interrupted discharge was used, with magnesium as the internal standard. For the other elements, a total burning method with d-c arc was used, with the magnesium internal standard. The standard deviations of determinations ranged from ±2.2 to ±6.6%. (auth)

40735 SPECTROPHOTOMETRIC DETERMINATION OF MICROQUANTITIES OF THORIUM USING THORIN IN ORGANIC MEDIA, PRIOR TO EXTRACTION WITH TBP-METHYLISOBUTYLKETONE. J. Gomez-Pantoja, J. Vera Palomino, and J. C. Petrement (Junta de Energia Nuclear, Madrid). Anales Real Soc. Esp. Fis. Quim. (Madrid). Anales Real Soc. Esp. Fis. Quim. (Madrid), Ser. B, 59: 351-64(May 1963). (In Spanish)

Some modifications in the extraction process and in the measurement conditions for the thorium determination method described by Everest and Martin are introduced and some other operations as the thorium reextraction from the organic to the aqueous phase are suppressed. Factorial designs at different TBP concentration levels in MIC and saline agent in the aqueous phase for the study at a constant acid concentration is made. Plotting the experimental results leads to a family of curves given by the equation: $\log E = 2 - [(K_1/K_2^n) - K_3]\, K_4^{c/2-1}$, where E is the percent of thorium extracted, n the concentration of saline agent in the aqueous phase, c the TBP concentration in MIC, and all others are constants. With this equation the equal curves in the n, c plane are obtained, from which the working optimum conditions can be deduced. Absorption spectra of the thorium–thorin complex in different organic solvents are obtained, choosing the ethyl alcohol as the most convenient. The influence and the elimination of numerous interferences, systematic and variable errors of the method are studied. Because of the modifications introduced, thorium concentrations of 1 to 20 μg/ml can be determined, instead of 400 to 800 μg/ml in the original method, and the reproducibility of the results, in spite of working at a lower range of concentrations, is increased. (auth)

40736 SPECTROPHOTOMETRIC DETERMINATION OF THE ELEMENTS RARE EARTH. II. ELIMINATION OF CORRECTION FACTORS. J. Vera Palomino, F. de la Cruz Castillo, and R. Fernandez Cellini (Junta de Energia Nuclear, Madrid). Anales Real Soc. Esp. Fis. Quim. (Madrid), Ser. B, 59: 365-78(May 1963). (In Spanish)

The application of correction factors, a technique usually used in the spectrophotometric determination of the rare earths, is not always correct and sometimes can produce great errors. A method for removing these errors is proposed by replacing the concentration factors corresponding to λ_{max} by those derived from taking into account the absorbance difference between λ_{max} and λ_e, where λ_e is a wavelength value properly chosen in every case. The new concentration factors are calculated, and the method is applied to the determination of elements of the cerium and yttrium groups. The results are compared with those obtained from the correction factors, as well as in rare earth concentrates obtained by means of ion exchange separation. (auth)

40737 DETERMINATION OF ^{14}C AND ^{3}H IN BIOLOGICAL MATERIAL. H.-L. Schmidt (Max-Planck-Institut fur Hirnforschung, Arbeitsgruppe Neurochemie, Marburg, Ger.). Atompraxis, 9: 349-56(Sept. 1963). (In German)

For determining the radioactivity of C^{14} and H^3, measurement in the gaseous phase, or with liquid scintillators, proved to be most suitable. Both methods require special preparation of the measurement material, which is often quite heterogeneous, particularly in biological laboratories. The efficiency of several special procedures, and the amount of effort they require, was studied for the purpose of ascertaining optimum measurement conditions for solving any given problem. A simple but versatile apparatus is described for dissolving biological samples for measurement of radioactivity in the gaseous phase. A procedure is also presented for determining the count yields in scintillation measurement of biological material. (auth)

40738 DETERMINATION OF TRITIUM IN TISSUE AND OTHER BIOLOGICAL SAMPLES. U. Feine (Universitat, Tubingen, Ger.). Atompraxis, 9: 357-8(Sept. 1963). (In German)

A modification of the Schöniger combustion method, which makes it possible to burn the sample without drying it beforehand, is described. Thus tritium water can be demonstrated in biological samples such as urine, serum, whole blood, and tissue. The sample is dried and ignited externally in the oxygen atmosphere of a 2-l Erlenmayer flask by means of an electric mirror burner. This simplifies the Schöniger method. (auth)

40739 DETERMINATION OF ELEMENTS IN MILLI-, MICRO- AND SUBMICROGRAM QUANTITIES IN HUMAN WHOLE BLOOD BY NEUTRON ACTIVATION ANALYSIS. D. Brune, K. Samsahl, and P. O. Wester (Aktiebolaget Atomenergi, Stockholm and Karolinska Institutet, Stockholm). Atompraxis, 9: 363-73(Sept. 1963). (In German)

By means of neutron activation analysis, Cu, Mn, Zn, Sr, Na, P, Ca, Rb, Cd, Sb, Au, Cs, and Fe were determined in normal human whole blood. The relation between the concentration of the elements in leukemic and that of elements in normal human whole blood was investigated. In one series significant difference was observed for the element Co. (auth)

40740 THE PRESENT STATE OF QUANTITATIVE X-RAY MICROANALYSIS. PART I: PHYSICAL BASIS. P. Duncumb and P. K. Shields (Tube Investments Research Labs., Cambridge, Eng.). Brit. J. Appl. Phys., 14: 617-25(Oct. 1963).

In the x-ray microanalyzer the intensity of characteristic emission excited by electron bombardment of a selected point on the specimen surface can be measured to a high degree of accuracy. To a first approximation, the mass concentration of a given element can be obtained from the intensity of its characteristic emission by direct proportionality, but to match the accuracy of experimental measurement, corrections must often be applied to this rule. These arise when elements widely different in atomic number are present and when absorption and fluorescence effects within the specimen are significant. Correlations of the methods proposed for evaluating these effects are discussed, particularly the atomic number and absorption corrections. (auth)

40741 THE PRESENT STATE OF QUANTITATIVE X-RAY MICROANALYSIS. PART 2: COMPUTATIONAL METHODS. G. D. Archard and T. Mulvey (Associated Electrical Industries, Aldermaston, Berks, Eng.). Brit. J. Appl. Phys., 14: 626-34(Oct. 1963).

In x-ray microanalysis, allowance must be made not only for absorption of x rays but also for the effects of penetration, diffusion, and backscattering of the incident electrons. In view of the impossibility of pursuing separately every electron path, a simplified diffusion model is proposed and calculations based on this are compared with experiment. Agreement is in many cases good, but some discrepancies remain for future investigation. (auth)

40742 THE SPECTROPHOTOMETRIC DETERMINATION OF URANIUM WITH DIBENZOYLMETHANE. Yoshini Umezaki (Resources Research Inst., Kawaguchi, Japan). Bull. Chem. Soc. Japan, 36: 769-73(July 1963). (In English)

Description is given of a simple direct spectrophotometric determination of uranium with dibenzoylmethane in combination with tributyl phosphate, which is selected as the extractant of uranium because of its popularity. The procedure was applied to the determination of U in U ores and in monazite. One advantage of the method is that change in acidity does not have any serious influence on the color intensity. (P.C.H.)

40743 2:3-DIHYDROXY-NAPHTHALENE-6-SULPHONIC ACID (SODIUM SALT) AS AN ANALYTICAL REAGENT FOR ZIRCONIUM. Brahm Dev and B. D. Jain (Univ. of Delhi). Current Sci. (India), 32: 306-7(July 1963).

2:3-dihydroxy-naphthalene-6-sulfonic acid (sodium salt) was used for the determination of Zr at pH 1.0 to 3.0. The reagent forms soluble colored complexes with Ti and U, and therefore the estimation of Zr can be carried out in the presence of large quantities of both. (P.C.H.)

40744 DETERMINATION OF THE CONCENTRATION OF C^{14} BY COUNTING TRACES. N. D. Perumova and L. E. Pakulina (Inst. of Oncology, Medical Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 152: 461-3(Sept. 11, 1963). (In Russian)

A technique is described for determining the concentration of C^{14} in a liquid sample by counting the number of tracks on a nuclear emulsion. The emulsion PR2 is particularly suitable because of its high content in silver bromide grains of very small size. Thus it is possible to detect even the tracks of short-range particles. The number of tracks is proportional to both the radioactivity of the sample and the time of exposure. The method was standardized by spreading a 1% solution of glycine-C^{14} in liquid gelatine on the nuclear emulsion, and counting the number of sensitized grains per square centimeter under a microscope. The best results were obtained when no more than 15 to 20 grains were present per unit area, since the tracks tended to overlap and to give lower counts than expected, at high values. A correction curve is given to correct the number of tracks counted to the real number of tracks present. (TTT)

40745 QUANTITATIVE INORGANIC CHROMATOGRAPHY. PART X. THE CHROMATOGRAPHIC SEPARATION AND AUTOMATIC FLAME SPECTROPHOTOMETRIC DETERMINATION OF THE ALKALINE-EARTH METALS. F. H. Pollard, G. Nickless, and D. Spincer (Univ. of Bristol, Eng.). J. Chromatog., 11: 542-8(Aug. 1963).

A continuous and automatic method of separation of microgram and milligram quantities of Ba, Ca, Mg, and Sr using cation-exchange chromatography was developed, using a flame spectrophotometer as a continuous automatic detector. The accuracy is within 5%, and complete separation and determination may be executed within 12 hr. (P.C.H.)

40746 METALLOGRAPHIC IDENTIFICATION OF INCLUSIONS IN URANIUM METAL. Jan Truchly and Frantisek Slancar (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Jaderna Energie, 9: 281-5(1963). (In Czech.)

Metallographic identification of uranium inclusions is described along with necessary methodic phases preceding the proper research of structural changes of irradiated and thermally cycled fuel. The method of identification of individual types of inclusions was elaborated enabling the evaluation of their influence on uranium behavior during its manufacture and use. (auth)

40747 THE APPLICATION OF LIQUID ION-EXCHANGE RESINS IN ANALYSIS. PART III. THE REACTIONS OF NIOBIUM AND URANIUM. H. Green. Metallurgia, 68: 143-5(Sept. 1963).

An outline is given of the investigation carried out to find the optimum conditions under which Nb and U extraction occurs using solvent extraction techniques combined with ion-exchange. It was found that Nb may be extracted by the exchanger from oxalic acid solutions, but when up to 98% may be removed with one extraction. In the presence of sulfuric acid the extraction of Nb decreases with increase in the level of free acid and maximum extraction occurs at a concentration of about 2% free sulfuric acid. Nb is best removed from the resin by back extracting with a 25% HCl solution containing oxalic acid, or by a 10% solution of potassium carbonate. U may be extracted by the exchanger from solutions containing free H_2SO_4. The amount extracted decreases with increase in the level of free acid and maximum extraction occurs at a concentration of about 1% free H_2SO_4. U may be back extracted from the resin using a 25% HCl solution or a 10% solution of sodium carbonate. (P.C.H.)

40748 MONITORING OF SEA-WATER FOR IMPORTANT RADIOISOTOPES RELEASED BY NUCLEAR REACTORS. Noboru Yamagata and Kiyoshi Iwashima (Inst. of Public Health, Tokyo). Nature, 200: 52(Oct. 5, 1963).

An analytical technique to measure very low concentrations of radioisotopes in sea water was developed. Manganese dioxide was found to be an effective and easily filterable scavenger for most of the radioisotopes in reactor

coolant water. After scavenging with MnO_2, a scintillation counter was used for determination of radioactivity. (M.C.G.)

40749 THERMAL NEUTRON ACTIVATION ANALYSIS OF TANTALUM IN SEA WATER. Hiroshi Hamaguchi, Rokuro Kuroda, Kyoichi Hosohara, and Tsuneo Shimizu (Tokyo Univ.). Nippon Genshiryoku Gakkaishi, 5: 662-5 (Aug. 1963). (In Japanese)

A thermal neutron activation method was worked out for the determination of traces of tantalum in sea water. Before irradiation tantalum was collected into iron hydroxide from 5 ~ 10 l of sea water sample with a satisfactory recovery. Air dried hydroxide was then irradiated along with a reference standard for a period of up to twelve days at the neutron fluxes of $\sim 3 \times 10^{11}$ n/cm^{-2}/sec^{-1}. Solvent extraction separation using hydrofluoric acid-sulfuric acid-isopropylacetone gave Ta^{182}(111 d) in radiochemically pure form. Activity measurements were taken on a β-proportional counter. As little as ~0.1 μg of tantalum in a 5 l of water sample can be determined this way. A detailed description is given for the solvent extraction separation of tantalum. Average tantalum content of sea water was estimated to be $0.00 \lesssim 0.02$ μg/l. (auth)

40750 ACTIVATION ANALYSIS OF ZIRCONIUM IN ZIRCONIUM–HAFNIUM MIXTURE. Yoshinaga Oka, Toyoaki Kato, and Michio Sasaki. Nippon Kagaku Zasshi, 84: 588-92(July 1963). (In Japanese)

Metals and oxides of Zr and Hf were photoactivated by bremsstrahlung produced by betatron and the residual radioactive nuclides were investigated in order to obtain the experimental condition for the determination of Zr in Zr–Hf mixtures. The individual metal or oxide was bombarded for 5 min by bremsstrahlung (maximum energy 24 Mev, maximum intensity $\sim 10^2$ röntgens/min/cm^2). With Zr target, Zr^{89m} produced by $Zr^{90}(\gamma,n)$ reaction was sufficient for the purpose of determining Zr after the relatively short life radionuclides, mainly 125 sec O^{15}, had decayed out. The residual radioactivity of photoactivated Hf target was not recognized for the same condition as described above. The total radioactivity of the photoactivated Zr–Hf mixture was, therefore, attributed to 4.4 min Zr^{89m}. As the internal standard, copper powder was homogeneously mixed with Zr–Hf mixture and the radioactivity of the residual 9.7 min. Cu^{62}, produced by $Cu^{63}(\gamma,n)$ reaction, was compared. When various mixtures of ZrO_2–HfO_2–Cu were photoactivated by the same condition as described above, the linear relationship was obtained between the ratios of the radioactivity, Zr^{89m}(cps)/Cu^{62}(cps), and the ratios of the weight, W_{ZrO_2}/W_{Cu}. Hence, the determination of Zr in Zr–Hf mixture was attained by mixing the known amount of copper powder with finely powdered sample to be analyzed followed by the photoactivation by the described condition and the subsequent analysis of decay curve to obtain the ratio of the radioactivity, Zr^{89m}/Cu^{62}. (auth)

40751 SINGLE CRYSTAL FOCUSING FOR SHORT-WAVE ROENTGEN QUANTOMETER. V. V. Steshenko, A. V. Pivovarov, and I. A. Rubanov (Inst. of Mineralogy, Dept. of Geology and Mineral Resources Conservation, Kazakh SSR). Pribory i Tekhn. Eksperim., No. 4, 189-90 (July-Aug. 1963). (In Russian)

A ten-channel spectrometer for qualitative x-ray analysis in the short-wave region is described. A quartz crystal analyzer and an eleven-channel monitor are used in the instrument. The line spectra for Ge, Rb, Y, Zr, Nb, Mo, Pb, Ta, Th, and U were obtained using the instrument. The accuracy of the instrument is 5–10%. (C.E.S.)

40752 MEASUREMENT OF BONE MINERAL IN VIVO: AN IMPROVED METHOD. John R. Cameron and James Sorenson (Univ. of Wisconsin, Madison). Science, 142: 230-2(Oct. 11, 1963).

The mineral content of bone can be determined by measuring the absorption by bone of a monochromatic low-energy photon beam from a radioactive source (iodine-125 at 27.3 kev or americium-241 at 59.6 kev). The intensity of the beam transmitted by the bone is measured by counting with a scintillation detector. Since the photon source and detector are well collimated, errors resulting from scattered radiation are reduced. From measurements of the intensity of the transmitted beam, made at intervals across the bone, the total mineral content of the bone can be determined. The results are accurate and reproducible within about 3 percent. (auth)

40753 APPARATUS FOR THE ANALYSIS OF RADIOACTIVE MINERALS BY THE γ-γ-β METHOD. Luciana Riva (Laboratori Centrali, CNRN, Casaccia) and Sebastiano Sciuti. Studi Ric. Div. Geomineraria, Comit. Nazl. Ric. Nucl., 3: 413-19(1960). (In Italian)

An apparatus that makes it possible to ascertain the respective ratios of uranium and thorium in radioactive minerals, also in those cases in which the uranium series is out of equilibrium, is described. The apparatus can be used for the analysis of concentrations $\geq 0.002\%$ of uranium and $\geq 0.005\%$ of thorium. (auth)

40754 SEMIQUANTITATIVE MICRODETERMINATION OF URANIUM BY MEANS OF PAPER FLUORESCENCE, APPLICATION TO THE RADIO ANALYSIS OF NATURAL WATER. G. Alberti, G. Grassini, and E. Di Ferrante. Studi Ric. Div. Geomineraria, Comit. Nazl. Ric. Nucl., 3: 447-54(1960). (In Italian)

A method for the semiquantitative microdetermination of uranium in natural waters is described. The method is based on the uv fluorescence obtained when a salt of uranium reacts on paper with sodium triphosphate and zinc acetate. This reaction can detect 0.001 γ of uranium in a dilution of $1:10^6$ and thus is much more sensitive than the usually employed reaction with ferrocyanide. Samples of natural waters (0.4 to 10 ml) were concentrated by evaporation onto the chromatogram. The uranium was then separated from interfering ions by ascending development with hexone HNO_3. The time required for a determination depends on the concentration of uranium (concentration of sample) and is 45 min for >25 γ/l and 3 hr for <25 γ/l. Since only a mineral light lamp and a hairdryer are used, the analysis can be carried out in the field. (auth)

40755 MASS SPECTROSCOPIC SOLIDS EXAMINATION. IMPROVED REPRODUCIBILITY WITH THE DIRECT-CURRENT BREAKING SPARK IN A VACUUM FOR ION PRODUCTION. K. D. Schuy and H. Hintenberger (Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 18a: 926-41(Aug.-Sept. 1963). (In German)

Mass spectra obtained with the disjunctive d-c spark in vacuum showed considerable improvement in accuracy and reproducibility over the conventional r-f spark of the Dempster type. Higher ion currents increased the speed of analysis. A number of mass spectra were produced with a spectroscopic steel standard. The methods of visual and photometric spectrum evaluation are discussed in detail, using two quantities defined as "element sensitivity" and "normalized ionization sensitivity." The former is a measure of how much more sensitive a given element can be photographically detected with the mass spectrograph than

the main component of the sample (matrix element), while the latter indicates how much more sensitive multiply-charged ions of an element can be detected on the plate than singly-charged ions of the same element. Both element and ionization sensitivities are reproducible to within approximately 20%. Furthermore, it was found, for most elements investigated, that the lines due to doubly-charged ions are more intense than those due to singly-charged ions and that the differences of element sensitivities of various elements decrease for ions of higher charge. The reproducibility of multiply-charged ions permits their use in the quantitative analysis of the sample. (auth)

40756 SPECIFIC METHOD FOR POTASSIUM DETERMINATION IN SOIL. L. E. Smirnov, V. N. Nataliina, and R. I. Kuznetsov. Zh. Analit. Khim., 18: 1051-3(Sept. 1963). (In Russian)

A simple and rapid method for the radiometric determination of potassium in soil was developed. The method is based on measuring the activity of K^{40}, which is present in natural potassium. The relative difference of the results obtained by the radiometric and potassium cobaltinitrite methods is, as a rule, not greater than ±6%. (auth)

40757 SPECTROPHOTOMETRIC STUDY OF THE INTERACTION OF ALUMINIUM(III) AND MOLYBDENUM(VI) IONS WITH XYLENOL ORANGE. DETERMINATION OF ALUMINIUM AND MOLYBDENUM IN URANIUM. B. Budesinskii (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Rzhezh). Zh. Analit. Khim., 18: 1071-4 (Sept. 1963). (In Russian)

Optimum conditions were found for the formation of Al^{3+} and Mo(VI) complexes with xylenol orange, their composition was established, and their association constants were calculated. A method was also developed for the determination of aluminum and molybdenum in uranium without separation. (auth)

40758 CHEMICO-SPECTROGRAPHIC METHOD FOR DETERMINATION OF IMPURITIES IN METALLIC NIOBIUM. N. N. Kuznetsova and L. S. Krauz. Zh. Analit. Khim., 18: 1090-3(Sept. 1963). (In Russian)

A chemico-spectrographic method, which is based on chemical concentration of impurities and subsequent spectrographic analysis, is suggested for determining metal impurities in niobium. The method includes bringing metallic niobium into solution by oxidating the sample to niobium pentoxide, which is then dissolved in sulfuric acid. It can be carried out in a quartz vessel. Impurities are concentrated by separating niobium from a sulfuric acid medium by extraction with a tributylphosphate solution in benzene. During the spectrographic analysis of the concentrated powder on the strontium sulfate base 15 elements can be determined simultaneously by means of a single spectrogram. Due to separation of niobium and concentration of the impurities the interference of the complex niobium spectrum is eliminated and the sensitivity of determination of all the elements is increased. (auth)

40759 DETERMINATION OF SMALL AMOUNTS OF WATER AND HYDROXYL GROUPS BY MEANS OF MASS SPECTROMETRICALLY MEASURED DEUTERIUM EXCHANGE. L. T. Zhuravlev, A. V. Kiselev, V. P. Naidina, and A. L. Polyakov (Inst. of Physical Chemistry, Academy of Sciences, USSR and Moscow State Univ.). Zh. Fiz. Khim., 37: 2054-61(Sept. 1963). (In Russian)

A method was developed for determining small amounts of water and hydroxyl groups on the surface of highly disperse bodies, without destruction of the latter, by deuterium exchange with heavy water. The exchange products are converted to hydrogen and the isotopic composition of the hydrogen is determined mass spectrometrically. Results of good reproducibility were obtained. The method is applicable for the determination in various materials of water accessible to exchange reaction, for instance such as that present on the surfaces of adsorbents, fillers, pigments, synthetic polymers, and many biopolymers. (auth)

40760 MEASUREMENT OF Ra^{226}, Th^{232} AND DAUGHTER PRODUCTS IN BIOLOGICAL SAMPLES. W. Stahlhofen and A. Kaul (Max-Planck-Institut für Biophysik, Frankfurt am Main). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/49, 19p. (CONF-104-35)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The mixing method for measuring low-level α activities is discussed in detail. The sample to be measured and the scintillator (ZnS[Ag]) are mixed in a certain proportion. The efficiency of this method is determined. The Th^{228} content of tissue samples of thorotrast patients was determined by this method. By the measurement of the total α activity, it was possible to estimate the Th^{232} content of the sample. The Ra^{226} content of the sample was determined by emanation method and considered at the calculation of the Th^{232} content. All samples were measured α-spectrometrically for Ra^{228} and Th^{228}. The results are compared with those of the α-coincidence method and agree within the limits of both methods. The same results were obtained by autoradiographic investigations. For in vivo measurements of the amount of incorporated Ra^{226}, an α-scintillation counter was developed for measuring the exhaled radon by electrostatic separation of the Rn daughters on a zinc sulphide layer. The lowest Rn concentration to be detected was of the order of 7×10^{-14} C Rn/l. This lower limit could be increased by a factor of 10 by the adsorption of Rn on activated charcoal. The amount of the elimination of the formed Rn within the body was determined in two cases of an industrial Ra poisoning by the measurement of both the exhaled Rn and the total body Ra^{226} content with the total body counter. (auth)

40761 AN X-RAY ABSORPTION METHOD FOR ELEMENTAL ANALYSIS. K. T. Knapp, R. H. Lindahl, and A. J. Mabis (Proctor and Gamble Co., Cincinnati). 11p. (CONF-174-5)

From 12th Annual Conference Application of X-ray Analysis, Denver, Aug. 1963.

A method of elemental analysis by x-ray absorption was developed. Measurements at two wavelengths, one on either side of an absorption edge for the element under study, are used. A development of the Beer's Law expressions through subtraction of the absorptivities at the two wavelengths, coupled with an initial choice of equal intensities for the two primary beams, leads to a linear calibration curve. The intercept of this curve is related only to the density and absorption properties of the matrix, while the slope is a linear function of the intercept and the absorption properties of the element. Once the slope of the calibration curve is determined for an element in one matrix, a calibration curve in another matrix can be determined with only absorption measurements on the new matrix itself. If the density and composition of the matrix are known the total calibration curve can be calculated without absorption measurements. The two wavelengths, one on either side of an element's absorption edge, are obtained by using the K_α and K_β radiation from an element just higher in atomic

number than the element to be analyzed. These are obtained in an x-ray spectrometer by using the target element in the sample position. The K_α and K_β radiations are then resolved with an appropriate analyzing crystal. The method is illustrated with analyses of several metals in dilute solutions of their salts, with good agreement between calculated and experimental results. The method is fast, nondestructive, and independent of the state of chemical combination of the element being analyzed. (auth)

40762 X-RAY SPECTROMETRIC ANALYSIS OF SOLUTIONS, A COMPARISON OF TECHNIQUES. Thomas J. Cullen (U. S. Metals Refining Co., Carteret, N. J.). 11p. (CONF-48-4)

From Conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Mar. 1963.

Although solution techniques appear to be ideal for x-ray spectroscopy, problems arise that must be compensated. Several ways of accomplishing this, by using various techniques of sample preparation, measurement of radiation, and sample cell design, are discussed. Careful attention to analytical techniques, such as dilution, pipetting, and loading of sample cells, produced results equal to those obtained from solid samples; that is, ±1.0% of the amount present. However, heat effects, bubble formation, and x-ray-induced reactions led to greater errors. (M.C.G.)

40763 DETERMINATION OF O^{18}. Saadia Amiel, Ramat Gan, and Aharon Nir. British Patent 940,056. Oct. 23, 1963. Priority date June 6, 1961, Israel.

A cheap nondestructive method for quantitative measurement of O^{18} is described. A sample whose O^{18} content is to be measured is bombarded with alpha particles with an energy of 4 to 9 Mev and the neutrons emitted from the sample are counted. These neutrons, originating in the (α,n) reaction with O^{18}, are proportional to the O^{18} content. (M.C.G.)

40764 SYSTEM FOR DETERMINING THE RADIOACTIVITY OF GAS SOLS. Jacob Hendrik Spaa (to North American Philips Co. Inc.). U. S. Patent 3,109,096. Oct. 29, 1963. Priority date Sept. 2, 1958, Netherlands.

A system for determining the radioactivity of gas sols is described for when at least part of the radioactivity is due to presence of radon and thoron associated with the sols. The system consists of a selective absorption means through which the radiation passes prior to detection and the joint absorption capacities for either alpha or beta type of radiation are such that the ratio between the detected beta particles and alpha particles for the daughter products of radon corresponds to that for the daughter products of thoron. If, in determining the radioactivity of a gas sol, the ratio between the detected beta particles and alpha particles is different from the ratio for radon and thoron daughters, then there is radiation resulting from other contamination present. (M.C.G.)

40765 EVAPORATION AND CONCENTRATION UNIT FOR DILUTE RADIOACTIVE AND NON-RADIOACTIVE SOLUTIONS. Ralph C. Maggio and Charles Christianson (to U. S. Navy). U. S. Patent 3,109,099. Oct. 29, 1963. Filed Mar. 23, 1961.

A method is described for measuring radioactivity, especially alpha and/or beta radiation, in liquids, particularly water. The solid matter is evaporated on a dish of selected geometry that is small compared to the area required for confining the liquid and small enough to be the objective of a Geiger-Mueller measuring instrument. (M.C.G.)

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Refer also to abstracts 40429, 41569, and 41614.

40766 (DP-434) OXIDATION OF NEPTUNIUM(V) BY VANADIUM(V). Ernest K. Dukes (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Nov. 1959. Contract AT(07-2)-1. 12p.

Rates of oxidation of neptunium(V) were determined by a solvent extraction technique based on the difference in distribution coefficients for neptunium(V) and neptunium(VI). The rate expression is $\{d[Np(VI)]/dt\} = K_i [Np(V)][H^+]^2[VO_2^+]$, where $K_i = 11.7 \pm 2.5$ mols^{-3} min^{-1} at 24°C. The activation energy for the reaction is 11.7 ± 0.4 kcal/mol between 24 and 50°C. Plutonium(IV) is not oxidized to an appreciable extent under the conditions used for the oxidation of neptunium(V). (auth)

40767 (DP-728) FORMATION OF HYDRAZOIC ACID FROM HYDRAZINE IN NITRIC ACID SOLUTIONS. E. K. Dukes and R. M. Wallace (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1962. Contract AT(07-2)-1. 13p.

A study was made of the kinetics and stoichiometry of the formation of hydrazoic acid in nitric acid solutions containing hydrazine and ferrous sulfamate. The data were used to establish safe limits for the use of hydrazine in process solutions. (auth)

40768 (HW-31186(Del.)) PRECIPITATION OF PLUTONIUM(IV) OXALATE. J. F. Facer, Jr. and K. M. Harmon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 30, 1954. Contract W-31-109-eng-52. 44p.

Conditions were determined for the precipitation of plutonium(IV) oxalate, $Pu(C_2O_4)_2 \cdot 6\,H_2O$, from plutonium nitrate solutions which contain 10 to 550 grams of plutonium per liter and from two to six molar nitric acid. The plutonium(IV) oxalate process proved adaptable to use with the following solutions: a) product from the Redox and Purex plants; b) product from the plutonium peroxide process in the Isolation Building; and c) product from Recuplex. The procedure requires the use of 0.5 to 1.0 weight percent hydrogen peroxide (for plutonium valence adjustment) and of enough oxalic acid solution to provide 0.1 molar oxalic acid in the supernatant after all of the plutonium is precipitated. Studies of procedural variations gave these results: a) Raising the strike temperature from 15 to 60°C increased the filterability of the precipitate. Strike temperatures of 70 to 75° or higher gave gummy precipitates. b) With pure stock solutions, plutonium(IV) oxalate solubility was smallest when the excess oxalic acid concentration in the slurry was between 0.04 and 0.16 molar. With as little as 10,000 parts of aluminum, iron, or chromium per million parts of plutonium in the feed solution, 0.10 molar excess oxalic acid was needed for low solubility. c) As the process was scaled up, it was necessary to increase the time required for oxalic acid addition in order to produce easily filtered precipitates. d) Any increase in the nitric acid concentration of the slurry above three molar increased the plutonium loss to recycle. e) Small changes in the filterability of the precipitate resulted from changes in agitator speed during the precipitation. f) The slurry had to be cooled to less than 10°C to prevent postprecipitation. Recommended procedures for precipitation of plutonium(IV) oxalate are described. (auth)

40769 (HW-76873) EXPERIMENTS ON THE PREPARATION OF URANIUM SUBOXIDES BY ELECTROLYTIC DEPOSITION. F. A. Scott (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 5, 1963. Contract AT(45-1)-1350. 10p.

Experiments were made to investigate the feasibility of producing uranium suboxides by electrolysis. Electrolytic depositions were made under various conditions from fused LiCl–KCl baths containing mixtures of uranyl and uranium(IV), pure uranium(IV), pure uranyl, and mixtures of uranium(IV) and (III). Visual observations and x-ray diffraction studies were made of the products. The products could not be completely characterized, but the results indicate that either UO_2, alone or mixed U + UO_2 phases are produced. Evidence was obtained for the production of a UOC compound in two of the runs. The uranium(IV) melts appear to contain at least some of an oxygenated species. It is concluded that the electrolytic production of uranium suboxides is not feasible. (D.L.C.)

40770 (HW-78461) THE ADSORPTION OF CESIUM, STRONTIUM, AND CERIUM ON ZEOLITES FROM MULTICATION SYSTEMS. B. W. Mercer, Jr. and L. L. Ames, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 19, 1963. Contract AT(45-1)-1350. 65p.

Cation exchange equilibria in binary systems of Cs^+, Sr^{2+}, or Ce^{3+} with other cations expected in fission product recovery solutions are presented for several zeolites (Linde 4AXW, 13X, AW-400, AW-500, Norton Zeolon, and clinoptilolite) along with a method of estimating zeolite loadings for multication systems. Strontium breakthrough curves are calculated from equilibrium and diffusion data for comparison with experimental breakthrough curves. Cesium and strontium loadings of about 1.5 and 2.5 meq/g of zeolite, respectively, were obtained with cesium and strontium feed solutions. Column results show 0.9 and 1.3 meq/g of cesium and strontium, respectively, loaded together on 4A from a simulated CSIREX 1BP solution. (auth)

40771 (IS-613) THE STRONTIUM–STRONTIUM HYDRIDE PHASE SYSTEM. D. T. Peterson and R. P. Colburn (Ames Lab., Ames, Iowa). [Feb. 20, 1963]. Contract W-7405-eng-82. 13p.

The Sr–SrH_2 phase diagram was studied by thermal analysis, chemical analysis of equilibrated phases, and x-ray diffraction. The maximum solubility of SrH_2 in strontium metal is 38 mole % at the peritectic temperature of 880°C. Strontium metal undergoes an allotropic transformation at 555°C and melts at 768°C. A second transformation was found, at about 240° C, in samples containing hydrogen. Strontium hydride was found to have an allotropic transformation at 855°C. (auth)

40772 (LADC-5361) KINETICS OF THE EXCHANGE OF CHLORINE ATOMS BETWEEN HYDROGEN CHLORIDE AND BENZYL CHLORIDE. SOLVENT EFFECTS. Warren Bruce, Milton Kahn, and Joseph A. Leary (New Mexico. Univ., Albuquerque and Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-eng-36. 24p.

The rate of exchange of chlorine atoms between hydrogen chloride and p-nitrobenzyl chloride (PNBC) in 82% dioxane–18% water by weight solution is represented by the rate law: $R_e = 2.59 \times 10^6\ [PNBC]e^{-20,900/RT} + 1.60 \times 10^9\ \alpha\ [HCl]\ [PNBC]e^{-19,900/RT}$, where α is the degree of dissociation of the hydrogen chloride and R_e is the rate of exchange in mole liter^{-1} sec^{-1}. The reaction mechanism is believed to be an example of concurrent S_N1 and S_N2 processes in which the chloride ion rather than the hydrogen chloride ion-pair is the effective nucleophilic reagent. Ordinary fluorescent light has no detectable effect on the rate of exchange, and the overall rate of exchange is decreased by added lithium perchlorate. Analytical expressions were developed which allow for the hydrolysis of the organic halide during the exchange. No exchange was detected between hydrogen chloride and p-nitrobenzyl chloride in anhydrous benzene after 363 hours at 60.00°. Similarly, no exchange was observed with benzyl chloride in benzene and acetone. The exchange with benzyl chloride proceeds at a faster rate in ethanol than in dioxane. In dioxane, p-nitrobenzyl chloride exchanges at a faster rate than benzyl chloride. (auth)

40773 (LADC-5656) THE CRYSTAL STRUCTURE OF $UMoC_2$. Don T. Cromer, Allen C. Larson, and R. B. Roof, Jr. (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 28p.

The structure of $UMoC_2$ was determined from single crystal x-ray data. The orthorhombic unit cell has the dimensions a = 5.625, b = 3.249, and c = 10.980 Å. There are four formula units per unit cell and all atoms are on the mirror planes in set 4(c) of space group Pnma. In the least-squares refinement of the structure a secondary extinction parameter and the real and imaginary portions of the anomalous dispersion corrections were used. The correction of Fourier coefficients for structures with anomalous scatters is discussed. There are no short C-C distances and this compound is not an acetylene type carbide. (auth)

40774 (LADC-5664) THE CRYSTAL STRUCTURE OF UF_4. Allen C. Larson, R. B. Roof, Jr., and Don T. Cromer (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 17p.

The crystal structure of UF_4 was determined from single crystal x-ray data. The monoclinic unit cell has the dimensions a = 12.73, b = 10.75, c = 8.43 Å and β = 126°20′; space group C2/c; and contains twelve formula units per unit cell. These cell dimensions are identical with those of Shankar, Khubchandani, and Padmanabhan (1957). In the least-squares refinement of the structure, a secondary extinction parameter and the real and imaginary portions of the anomalous dispersion corrections were used. Normal interatomic distances were observed. Uranium atoms have as neighbors eight fluorine atoms arranged in a slightly distorted antiprism configuration. (auth)

40775 (NASA-SP-3001) THERMODYNAMIC PROPERTIES TO 6000°K FOR 210 SUBSTANCES INVOLVING THE FIRST 18 ELEMENTS. Bonnie J. McBride, Sheldon Heimel, Janet G. Ehlers, and Sanford Gordon (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). 1963. 330p.

Consistent tables of thermodynamic properties at temperatures from 0 to 6000°K were compiled for 210 gaseous and condensed species involving the elements with atomic numbers of 1 to 18. The tables give the following thermodynamic functions for the standard state: heat capacity at constant pressure C_p^0, sensible enthalpy $H_T^0 - H_O^0$, entropy S_T^0, sensible free energy $-(F_T^0 - H_O^0)$, and H_T^0, the sum of sensible enthalpy and chemical energy at 0°K, as well as values of the enthalpy changes and the logarithms of the equilibrium constants. The latter two functions are given for the reactions of formation of the substances from a set of assigned reference elements ($(\Delta H_T^0)_f$ and $\log_{10} K_f$) and from these elements in their atomic gaseous state (ΔH_T^0 and $\log_{10} K$). The functions for most of the gases were generated from molecular data, whereas the func-

tions of most of the condensed species are based on selected experimental data that were smoothed and made self-consistent. (auth)

40776 (R63SD34) THE CHEMICAL KINETICS OF ATMOSPHERIC DEIONIZATION. M. H. Bortner (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Sept. 1963. Contract AF19(604)-8820. 91p. (AD-418311)

The chemical kinetics of the atmosphere determines its composition and changes therein. This is true in the case of an abnormally highly ionized atmosphere such as that existing after a nuclear burst. This study is directed toward the understanding of the chemical kinetics of such an atmosphere. The reaction mechanisms and rates therefore were studied in detail. The effect of various combinations of reactions on composition was considered and is discussed. The rates of the individual reactions and the available data on these rate constants were investigated. Considering the large uncertainties in the values of many of the rate constants and the importance of each of the individual reactions, suggestions are made of reactions which are most in need of further investigation. A summary of recommended values for the rate constants is given. (auth)

40777 (RAD-SR-63-183) THERMODYNAMICS OF CERTAIN REFRACTORY COMPOUNDS. PART II. CONTINUED THEORETICAL AND EXPERIMENTAL STUDIES ON AN EXTENDED LIST. Quarterly Progress Report No. 5, June 1, 1963 to August 31, 1963. H. L. Schick, D. F. Anthrop, R. E. Dreikorn, P. L. Hanst, and M. B. Panish (Avco Corp., Research and Advanced Development Div., Wilmington, Mass.). Sept. 15, 1963. Contract AF33(657)-8223. 261p. (AD-418437)

The primary objective of this project, to evaluate and compile thermodynamic data for the refractory borides, carbides, nitrides, and oxides of some 31 elements, is being continued. As in the previous quarter, the compounds of the following 10 elements are being emphasized as follows: zirconium, hafnium, tantalum, tungsten, niobium, titanium, molybdenum, thorium, beryllium, and silicon. Complete data evaluations and thermodynamic tables are presented for 25 compounds. These include beryllium nitride, hafnium dioxide gas, molybdenum carbides (2), niobium diboride, niobium oxides (5), silicon oxides (2), vanadium dioxide (gas), and zirconium oxides (2). Experimental studies which have been devoted to a spectroscopic study of the vapors of silicon carbide have been discontinued because of difficulties in achieving high temperatures in the apparatus. (auth)

40778 (TID-6036) BERYLLIA HYDROLYSIS. M. E. Lapides (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 29, 1958. Contract [AT(11-1)-171]. 33p. (DC-58-9-21)

A summary and compilation are given of information developed by the Power Systems, Design and Evaluations Unit on beryllia hydrolysis problems. The information includes system equilibria and corrosion kinetics, studies of beryllia hydrolysis deposition, and miscellaneous studies. (D.L.C.)

40779 (TID-15242) THE INFRARED SPECTRA AND BONDING OF COBALT CARBONYL HYDRIDE AND COBALT CARBONYL DEUTERIDE. Walter F. Edgell, W. E. Wilson, R. Summitt, and W. C. Nieuwpoort (Purdue Univ., Lafayette, Ind.). [1961]. Contract AT(11-1)-164. 38p.

Infrared spectra were obtained from 2 to 33 microns of $HCo(CO)_4$ and $DCo(CO)_4$ in the gas phase over a wide range of pressures (to 50 mm Hg) and path lengths (to 5 m), and in the 300-600 cm^{-1} region of solid films of $HCo(CO)_4$ dispersed in hexane at −195°C. Three fundamentals involving the H atom were located, as well as weak bands in the 300-600 cm^{-1} region which could be assigned as skeletal fundamentals. Stretching frequencies of Co-H and Co-D were located at 1934 and 1397 cm^{-1}, respectively. Two strong hydride bands at 703 and 331 cm^{-1} shift to 600 and 296 cm^{-1}, respectively, and are assigned as mixed modes resulting from the interaction of a "pure" H bend and a "pure" CO bend. The Teller-Redlich ratio product for all deuteration shifts is ~2, indicating cylindrical symmetry, probably C_3. An assignment of frequencies is made and the spectra are consistent with a model of C_{3v} symmetry, with H bonded to Co. Bonding of H and the CO groups is discussed. (auth)

40780 (TID-19487) VIBRATIONAL SPECTRA OF INORGANIC COMPOUNDS. Annual Progress Report, September 1, 1962–September 1, 1963. Foil A. Miller (Mellon Inst., Pittsburgh). Contract AT(30-1)-1993. 17p.

A brief description is given of the research being conducted on the cyanoethylenes, $P(CN)_3$, metal cyanide complexes, CF_3NCO, CH_3NCO, Al_2Cl_6, $B(NCS)_3$, $CF_3C \equiv CH$, and $CF_3C \equiv CD$. Plans for future research are outlined. (D.L.C.)

40781 (UCRL-10595) ION EXCHANGE STUDIES IN CONCENTRATED SOLUTIONS. I. THE ALKALI CATIONS WITH A SULFONIC ACID RESIN. D. C. Whitney and R. M. Diamond (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 1962. Contract W-7405-eng-48. 36p.

An investigation of the cation exchange behavior on Dowex-50W (sulfonic-acid type) resin of Na, Rb, and Cs tracers in 0.1 M to saturated solutions of $HClO_4$, HCl, HNO_3, $HC_2H_3O_2$, the corresponding Li salts, and CsCl was made. The exchange in dilute solutions is discussed in terms of the competition for solvation of the cation between water and the resin sulfonate groups. As the aqueous phase concentration rises, deviations from the simple mass-action law behavior occur; these deviations are explained in terms of the decreasing water activity, increasing cation-anion interactions in both the resin and aqueous phases, and resin invasion by nonexchange aqueous electrolyte. Individual differences among the various salts and acids are related to the different water activities and extent of anion-cation interactions present in the aqueous phase. (auth)

40782 (HW-tr-54) STUDY OF THE OXIDATION OF CARBONS BY AIR AND CARBON DIOXIDE AS A FUNCTION OF THEIR STRUCTURE AND THEIR STATE OF PURITY. F. M. Lang, P. Magnier, and S. May. Translated by R. E. Woodley (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.), from p.171-93 of "Proceedings of the Fifth Conference on Carbon. Vol. I" (publication of Pergamon Press, 1962). 49p.

Results are reported of studies of the physical and chemical characteristics of various carbons and graphites (impurities, structure, texture, permeability, density, porosity, etc.) and of the kinetics of oxidation by air and CO_2. The effects of moisture on the oxidation rates were studied. Thiele's theory is applied to the experimental data. (D.L.C.)

40783 ON THE PROPERTIES OF TiS_3, ZrS_3, AND HfS_3. Haakron Haraldsen, Arne Kjekshus, Erling Roest, and Arne Steffensen (Universitetet, Oslo). Acta Chem. Scand., 17: 1: 83-92(1963). (In English)

Tensimetric analysis of the hafnium-sulfur system is reported and discussed, particularly in relation to similar measurements on titanium, zirconium, niobium, tantalum, and uranium sulfides. The properties of the polysulfide compounds TiS_3, ZrS_3, and HfS_3 were studied by means of x-ray diffraction methods and magnetic susceptibility measurements. The redetermined lattice constants are: TiS_3, a = 4.973, b = 3.433, c = 8.714 Å, β = 97.74°; ZrS_3, a = 5.123, b = 3.627, c = 8.986 Å, β = 97.15°; and HfS_3, a = 5.100, b = 3.594, c = 8.992 Å, β = 98.16°. The compounds have almost zero magnetic susceptibility. (auth)

40784 THE CRYSTAL STRUCTURE OF $Nb_{12}O_{29}$(O-RH). Rolf Norin (Univ. of Stockholm). Acta Chem. Scand., 17: 1391-1404(1963). (In English)

The crystal structure of $Nb_{12}O_{29}$(o-rh) was studied using single-crystal x-ray methods. The unit cell has the dimensions: a = (28.90 ± 0.02); b = (3.835 ± 0.002); c = (20.72 ± 0.02); and V = 2296 $Å^3$ and contains 4 units of $Nb_{12}O_{29}$. The proposed structure has the symmetry Amma and may be described in terms of regular NbO_6-octahedra, which share edges and corners to form an infinite three-dimensional framework. A monoclinic modification of $Nb_{12}O_{29}$ was identified from its powder pattern. (auth)

40785 ON THE CRYSTAL STRUCTURE OF THE MANGANESE(III) TRIOXIDES OF THE HEAVY LANTHANIDES AND YTTRIUM. H. L. Yakel (Oak Ridge National Lab., Tenn.), W. C. Koehler, E. F. Bertaut, and E. F. Forrat. Acta Cryst., 16: 957-62(Oct. 10, 1963).

The preparation, determination of optical properties, and approximate crystal structure of the ferroelectric manganese (III) trioxides of Ho, Er, Tm, Yb, Lu, and Y are reported. The compounds crystallize in the hexagonal system, probable space group $P6_3cm$, and their structure is characterized by unusual five- and sevenfold coordination polyhedra about manganese and rare-earth atoms, respectively. The unacceptable values assumed by the temperature factors of two oxygen ions throw doubt on the exact determination of atom positions by least-squares refinement. Possible causes of this difficulty are reviewed. (auth)

40786 THE CRYSTAL STRUCTURE OF γ-UO_3. R. Engmann and P. M. de Wolff (Technische Hogeschool, Delft, Netherlands). Acta Cryst., 16: 993-6(Oct. 10, 1963).

The structure of γ-UO_3 was determined from powder diffraction data, integrated diffractometer intensities being used. The structure is regarded as tetragonal with a = 6.89, c = 19.94 Å, though actually γ = 90.34°. Uranium is found to occur in two 8-fold positions of the space group $I4_1/amd$, both in octahedral coordination. Of the three 16-fold oxygen positions, one is found to have only one uranium neighbor. (auth)

40787 DETERMINATION, LATTICE CONSTANTS, AND SPACE GROUPS OF $LiEuO_2$. H. Baernighausen (Universitat, Freiburg i. B.). Acta Cryst., 16: 1073(Oct. 10, 1963). (In German)

For the preparation of $LiEuO_2$, LiO and Eu_2O_3 were mixed under dry nitrogen and heated for 12 hr at 800°C. X-ray analysis of the crystal structure gave the following lattice constants: a = 11.405 ± 0.001, b = 5.3353 ± 0.0005, and c = 3.4711 ± 0.0003 Å. Interference data on Guineir absorption are presented. (M.C.G.)

40788 PRODUCTION, PROPERTIES, AND CRYSTAL STRUCTURE OF POTASSIUM-HEXAFLUOROTECHNETATE(IV). K. Schwochau and W. Herr (Kernforschungsanlage, Julich, Ger. and Universitat, Cologne). Angew. Chem., 75: 95-6(1963). (Jul-104-RC). (In German)

$K_2(Tc^{99}F_6)$ was obtained by melting $K_2(TcBr_6)$ with KHF_2. The solubility of the salt amounted to 1.5 g/100 g water at 25°C. Absorption spectra were determined. The fluorotechnetate showed good stability against hydrolytic decomposition. X-ray structural investigations gave the following values for lattice constants: a = 5.807 ± 0.002 and c = 4.645 ± 0.002 Å. The density was determined to be 3.58 ± 0.01 g/cm^3. (M.C.G.)

40789 STUDY OF THE DISTRIBUTION OF ALUMINUM HYDROXIDE BETWEEN WATER AND SATURATED WATER VAPOR. M. A. Styrikovich, O. I. Martynova, K. Ya. Katkovskaya, I. Ya. Dubrovskii, and E. I. Mingulina. At. Energ. (USSR), 15: 161-3(Aug. 1963). (In Russian)

Atomic power stations operating on a single circuit require a higher purity steam than ordinary thermal plants. In view of the fact that contaminants in the water–steam portion become more soluble at high pressures, the transfer of the nonvolatile components of corrosion products into the vapor phase was investigated in the case of Al, using a colorimetric method. The distribution coefficient of A100H was measured as a function of the pressure and the pH of the solution. The value of the coefficient was found to be higher at 185 atm than at 100 atm; this agrees with the previous assumption that the solubility in saturated steam increases with increasing pressure. Increasing or decreasing the pH from its maximum value between 8 and 8.7 results in a sharp decrease of the distribution coefficient. (TTT)

40790 THE STABILITY OF THE FLUORIDE COMPLEXES OF TETRAVALENT URANIUM. V. M. Vdovenko and G. A. Romanov. At. Energy. (USSR), 15: 168-9(Aug. 1963). (In Russian)

Previous measurements concerning the instability constants of the UF^{3+}, UF_2^{2+}, and UF_3^{+} complexes exhibited differences of about 3 orders of magnitude with respect to other literature data. The calculations carried out indicated that only a negligible portion of the U in equilibrium with the solid phase $U(OH)_4$ is present as a simple U^{4+} ion. Consideration of the U(IV) hydrolysis causes the instability constant to be reduced by the required factor, bringing it within the range of previous findings. Taking into account previous studies on the dependence of the proton relaxation time T_1 of U(IV) solutions in 2N $HClO_4$ on the concentration of the F ion, it was found that in the case of $F^-/U^{4+} = 1$, the value of $1/T_1$ reaches a maximum, indicating the formation of a UF^{3+} complex. From reaction with Al fluoride, the instability constants of the U(IV) and Al(III) fluoride complexes were arranged in the following manner: $K_{UF^{3+}} < K_{AlF^{2+}} < K_{UF_2^{2+}} < K_{AlF_2^{+}}$ with the following values obtained: 7×10^{-8}; 7.4×10^{-7}; 5.5×10^{-6}; and 9.5×10^{-6}. This series agrees with previous results on U(IV) and with the data reported by K. E. Kleiner (Zh. Obsh. Khim, 20: 1747(1950)). (TTT)

40791 THE THERMAL CONDUCTIVITY OF ALKALINE EARTH OXIDES. N. A. Surplice and R. P. Jones (Univ. of Keele, Staffs, Eng.). Brit. J. Appl. Phys., 14: 720-2(Oct. 1963).

The comparative thermal conductivities of sintered powders of alkaline earth oxides were measured in vacuum over the range of temperatures 450 to 720°C. The thermal conductivities of MgO, CaO, SrO, and (BaSr)O were between 0.3×10^{-5} and 2.5×10^{-5} cal sec^{-1} cm^{-1} $degC^{-1}$, but the thermal conductivity of BaO was at least four times as great, i.e., 8×10^{-5} to 11.5×10^{-5} cal sec^{-1} cm^{-1} $degC^{-1}$. Possible reasons for this anomaly are discussed; the most likely reason seems to be some difference in the physical structure of the sintered barium oxide. (auth)

40792 SORPTION OF RADIOACTIVE ISOTOPES ON PRECIPITATES. IX. SORPTION OF SMALL AMOUNTS OF ZIRCONIUM, RUTHENIUM, AND URANIUM ON MANGANESE(IV) HYDROXIDE. EFFECT OF COMPLEX FORMATION ON THE SORPTION VELOCITY. Z. Kolařík and J. Szlaur (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Řež and Tech. Univ., Prague). Collection Czech. Chem. Commun., 28: 1993-2004(Aug. 1963). (In German)

The mutual exchange of Zr^{4+}, Ru(III) nitrosyl, and U^{6+} ion for hydrogen ions in a $Mn(OH)_4$ precipitate was investigated. The validity of the mass effect law was established, the composition of the sorption complexes formed was determined, and their equilibrium formation constants were measured. The effects of the hydrolysis of the ruthenium nitrosyl ions and of the formation of zirconium sulfate complexes on the sorption equilibrium were indicated. The compositions of the hydrolytic ruthenium nitrosyl and zirconium sulfate complexes under the conditions given were determined, and their stability constants were calculated. (tr-auth)

40793 DESIGN OF INDUSTRIAL ION EXCHANGE EQUIPMENT OF RARE EARTH ELEMENTS. Keijiro Nishigori. Denki Shikensho Iho, 26: 66-75(Jan. 1962). (In Japanese)

The design of industrial ion exchange equipment is presented. This equipment has twenty ion exchange towers and the capacity of each tower is 400 l of strong acid type resin. Purification of 200 kg of rare earth elements (as oxide) is possible by using this equipment. (auth)

40794 THE HEAT CAPACITY OF WATER AT CONSTANT VOLUME OF THE LIQUID AND VAPOR PHASE IN THE SINGLE AND TWO-PHASE REGIONS ON EACH SIDE OF THE CRITICAL POINT. Kh. I. Amirkhanov and A. M. Kerimov. Dokl. Akad. Nauk, 151: 1064-7(Aug. 11, 1963). (In Russian)

The specific heat of water c_v was determined near the critical point at a minimum temperature interval of 0.08°C with a minimum increase in specific volume of 0.1 cm^3/g. A study of the heat capacity along 15 isochores near the critical point was carried out, and the results show the heat capacity along the isochores as a function of temperature and specific volume, as the water changes from a heterogeneous state to a homogeneous state. The value of c_v increased by 20 to 25% for specific volumes of 2.6 $cm^3/g < V < 2.8$ cm^3/g with a temperature increase of 0.12°C. This increase in specific heat near the critical point was a factor of 100 greater than the increase in specific heat far from the critical point with the same temperature rise. The transition from the two-phase to the single-phase state was continuous but sharp. A transition or critical region existed within the interval of specific volumes of 2.6 to 3.8 cm^3/g. This intermediate state was very mobile. The smooth change in heat capacity near the critical point on going to a single-phase state cannot be explained by the effect of gravity. The maximum values of c_v were determined for the isochores: V = 3.23, 3.24, 3.25, and 3.26 cm^3/g. Calculations showed that the maximum energy of the transition $\Delta Q = 1.38$ cal/g is obtained for V = 3.24 cm^3/g, and hence, that a critical isochore of V = 3.24 cm^3/g should be taken as the critical value (the literature value of V = 3.26 cm^3/g is therefore considered incorrect). The time transition temperature along the critical isochore was found to be 374.07°C (0.08° lower than the critical temperature given in the literature). If the temperature at the end of the sharp change in c_v is taken as the temperature of the end of the transition, the critical temperature of water is equal to 374.21°C. (TTT)

40795 RESULTS OF AN X-RAY STUDY OF CERIUM AND LANTHANUM HYDRIDES. E. E. Vainshtein, M. N. Bril', I. B. Staryi, and M. E. Kost (Inst. of Inorganic Chemistry, Academy of Sciences, Siberian SSR; Kurnakov Inst. of Inorganic Chemistry, Academy of Sciences, USSR; and Ushinskii Teachers Inst., Odessa). Dokl. Akad. Nauk SSSR, 151: 1360-3(Aug. 21, 1963). (In Russian)

Trihydrides of Ce and La were prepared by direct reaction of hydrogen with the metal at room temperature. Three lanthanum hydrides $LaH_{2.66}$, $LaH_{2.26}$, and $LaH_{1.97}$, and four cerium hydrides $CeH_{2.97}$, $CeH_{2.59}$, $CeH_{2.24}$, and CeH_2 were prepared by heating the trihydride in vacuum and pumping off the hydrogen gas. These lower hydrides were stable in vacuum ($\sim 10^{-3}$ mm Hg std) at room temperature. The hydrides were hot pressed between sheets of plastic, and stored in vacuum or dry CO_2 to avoid reaction with oxygen or water vapor in the air. The LIII x-ray absorption spectra were taken on a focusing vacuum spectrograph with a second-order reflection from the (1011) plane of a bent quartz crystal. The resolution of the instrument was 7500. Ce and La hydrides did not show any fine structure. The cerium and lanthanum were trivalent in these hydrides. No change in structure and in position of the L-spectra can be observed on going from the dihydride to the trihydride. Hence, there is no change in valence state of the rare earth metal in these compounds. The compound becomes more ionic on going from the dihydride to the trihydride with a decrease in electrical conductivity. (TTT)

40796 VIBRATION SPECTRA OF ALKALI METAL FLUOROBERYLLATES M_2BeF_4. A. I. Grigorev, Yu. V. Orlova, V. A. Sipachev, and A. V. Novoselova (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 152: 134-6(Sept. 1, 1963). (In Russian)

The crystal lattice of fluoroberyllates M_2BeF_4 consists of tetrahedral anions BeF_4^{2-} linked to cations of alkali metals. Regular tetrahedra show 4 perpendicular oscillations, all giving Raman spectra with only two giving absorption spectra. Absorption spectra in the region 300 to 1000 cm^{-1} were studied for Li_2BeF_4, Na_2BeF_4, K_2BeF_4, Rb_2BeF_4, and Cs_2BeF_4. K_2BeF_4 showed two absorption bands at about 386 cm and 800 cm^{-1} (ν_4 and ν_3) related to degeneration of oscillation triplets, that is, respectively, a deformation oscillation and a valence oscillation. The Raman spectrum showed a band at 560 cm^{-1} (ν_1) and a weak band at 388 cm^{-1} (ν_4). The other two theoretical bands were very weak and could be detected only by repeated exposures (ν_3 at 800 cm^{-1} and ν_2 at 260 cm^{-1}). The adsorption spectra triplets (ν_3) of the potassium, rubidium, and cesium fluoroberyllates were very asymmetric. This can explain the lowering of symmetry of BeF_4^{2-} from the symmetry group T_d to the group C_{3v} (spacial group D_{2h}^{16}, z = 4). The deformation of the tetrahedron was more evident in the spectrum of Na_2BeF_4 (D_{2h}^{16}, z = 4). The spectrum of the latter compound split at 560 cm^{-1} (ν_1) into two symmetrical bands. The spectrum of Li_2BeF_4 showed three maxima at 785, 809, and 864 cm^{-1} (ν_3). The fluoroberyllates also exhibited weak frequencies in the region of 900 to 1000 cm^{-1}, evidently due to harmonics or combination frequencies. The frequency ν_5 for potassium, rubidium, and cesium fluoroberyllates can be interpreted as the sum of the frequencies $\nu_3 + \nu_1$. The constant of valence forces for Be–F (K_{Be-F}) was 3.5×10^{-5} dynes/cm which is comparable to the analogous constants for the ions BF_{4-} (= 6.91×10^{-5} dynes/cm) and CF_4 (= 9.14×10^{-5} dynes/cm). (TTT)

40797 PREPARATION OF CERIROUGE. A. J. Singh, K. M. Abubacker, N. S. Krishna Prasad, and G. S. Rao (Atomic Energy Establishment, Trombay, India). Indian J. Technol., 1: 394-6(Oct. 1963).

The preparation of Cerirouge from mixed rare earth chlorides under different conditions was studied with the object of establishing conditions for obtaining a product of the desired fineness, suitable for optical glass polishing. Precipitation of rare earths with ammonium carbonate followed by decomposition of 1000°C, gives the most satisfactory product. (auth)

40798 SHORT-RANGE INTERACTIONS OF AQUEOUS IONS. L. B. Magnusson (Argonne National Lab., Ill.). J. Chem. Phys., 39: 1953-61(Oct. 15, 1963).

Data on the 1-1 fluoride complex ion with noble-gas-type cations are examined for information on short-range ion–ion and water–ion interactions. A four-term numerical correlation of the standard free energies with the size and charge of the ion was developed based on the approach that electric saturation is not directly important to the complex formation. Deviations from the classical point charge Coulomb energy are expressed by a term independent of temperature and the dielectric medium, exponential in the separation distance, and containing only fundamental quantities, which suggest wave-mechanical interaction between cation and anion. The total standard entropy change separates into three terms; the temperature dependence of the macroscopic dielectric constant, the removal of coordinated water, and the cratic term for the change in the number of solute particles. A screened charge model of the hydrated ion is proposed in which hydration is the loss of the quantum-mechanical free energy of the gaseous ions by the formation of covalent bonds with the water. The ion charge is delocalized, spreading out to the coordinated water. The degree of hydration depends on the free energy of the water, with the free energy for coordination of the last water molecule being less than 1 kcal. (auth)

40799 ELECTRIC POLARIZABILITY OF SOME DIATOMIC MOLECULES. H. J. Kolker and M. Karplus (Columbus Univ., New York). J. Chem. Phys., 39: 2011-16(Oct. 15, 1963).

A variation-perturbation method is employed for the calculation of the electric polarizability tensor of a series of diatomic molecules (H_2, Li_2, N_2, LiH, HF, LiF, CO). SCF-LCAO-MO functions were used as unperturbed solutions and appropriately orthogonalized perturbation functions were introduced to account for the effect of the electric field. For the three molecules (H_2, N_2, CO) for which experimental data are available, reasonable agreement between the theoretical and the measured values was obtained. However, the calculations appear to somewhat overestimate the electric polarizability, particularly so for the parallel component of the tensor; possible theoretical refinements to reduce the error are discussed. (auth)

40800 NMR SHIFT AND DIFFUSION STUDY OF ELECTROLYTES IN 50% DIOXANE-WATER MIXTURES. Anthony Fratiello and Dean C. Douglass (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 39: 2017-22(Oct. 15, 1963).

High-resolution chemical shift measurements were carried out on electrolytic solutions in 50% dioxane-water mixtures. Whereas the water proton resonance position was displaced significantly by the addition of electrolyte, the dioxane signal in all mixtures remained unperturbed. Further, the results, particularly those obtained with chloride solutions of the small or highly charged Be, La, and Th ions, indicated that strong selective solvation of cations by the water was occurring. This conclusion was substantiated by differences in the dioxane and the water linewidths observed in several solutions, including those of paramagnetic salts. Self-diffusion coefficients of dioxane in the electrolytic mixtures were also measured by the nuclear magnetic resonance spin-echo technique. The observed diffusion data could be interpreted solely on a hydrodynamical basis, again indicating that no significant interaction was occurring between dioxane and the added electrolyte. (auth)

40801 GEOMETRY OF THE ALKALINE-EARTH DIHALIDES. L. Wharton, R. A. Berg, and W. Klemperer (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 39: 2023-31(Oct. 15, 1963).

It is shown by the deflection of beams of alkaline-earth dihalide molecules by inhomogeneous electric fields that the following compounds have permanent electric dipole moments and are therefore assumed bent: BaF_2, $BaCl_2$, $BaBr_2$, BaI_2, SrF_2, $SrCl_2$, and CaF_2. No polarity was observed for $CaCl_2$, $CaBr_2$, $SrBr_2$, and SrI_2. The absence of deflection of beams of $BaCl_2$ by inhomogeneous magnetic fields shows that this molecule has no electronic magnetic moment and hence is in a singlet ground state. (auth)

40802 NEAR-INFRARED STUDIES OF THE STRUCTURE OF WATER. I. PURE WATER. K. Buijs and G. R. Choppin (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). J. Chem. Phys., 39: 2035-41(Oct. 15, 1963).

The absorption bands of water in the 1.1- to 1.3-μ region were measured. From the extinction coefficients, concentrations of water species involving 2, 1, and 0 hydrogen bonds per molecule were calculated. The temperature dependence of these concentrations yielded a value of 3.7–4.5 kcal for the energy involved in breaking one mole of hydrogen bonds in water. On melting, 46% of the hydrogen bonds originally present in ice are broken; by 72°C the percentage broken has increased to 61. Further, the results were used in conjunction with a flickering cluster model to obtain an upper limit for the average size of the water polymers of 90 molecules of H_2O at 20°C. (auth)

40803 NEAR-INFRARED STUDIES OF THE STRUCTURE OF WATER. II. IONIC SOLUTIONS. G. R. Choppin and K. Buijs (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). J. Chem. Phys., 39: 2042-50(Oct. 15, 1963).

The infrared absorption bands of water in the 1.1- to 1.3-μ region were studied. Variations in intensities of three bands were used to calculate for ionic solutions the mole fractions of water molecules in which zero, one, and two of the hydrogens are involved in hydrogen bonding. The average sizes of water clusters in HCl, HBr, HNO_3, $HClO_4$, H_2O_2, NaOH, KOH, $NaNO_3$, and $NaClO_4$ solutions were calculated. From this and from qualitative evaluations for other solution systems, it was possible to assign the effects of the ions on the structure of water. (P.C.H.)

40804 ANISOTROPY OF THE FLUORINE CHEMICAL SHIFT TENSOR IN XENON TETRAFLUORIDE. R. Blinc (Nuclear Inst. "Jozef Stefan", Ljubljana, Yugoslavia), I. Zupancic, S. Maricic, and Z. Veksli. J. Chem. Phys., 39: 2109-10(Oct. 15, 1963).

Shift anisotropy in XeF_4 was investigated and attempts were made to determine the differences between the principal values of the F^{19} shift tensor in XeF_4 as precisely as possible. In all cases studied the line shape was sufficiently close to that expected for the case of axial symmetry of the shift tensor so that the second moment method could be used to determine the shift

anisotropy. The difference in the principal values of the shift tensor was determined to be $\Delta\sigma = 5.7 \times 10^{-4}$. From the results it was concluded that the Xe-F distance at −110 C should be a little bit shorter than previously suggested by room-temperature diffraction data. (P.C.H.)

40805 ISOPIESTIC VAPOUR-PRESSURE MEASUREMENTS OF AQUEOUS SALT SOLUTIONS AT ELEVATED TEMPERATURES. PART III. B. A. Soldano and M. Meek (Oak Ridge National Lab., Tenn.). J. Chem. Soc., 4424-6 (Sept. 1963).

Experimental osmotic coefficients for representative aqueous salt solutions at 140° are presented as a function of concentration. Osmotic coefficients are briefly compared as functions of temperature (25, 100, 121, and 140°C) and of concentration. (auth)

40806 CHEMISTRY OF THORIUM. PART IV. INTERACTION OF THORIUM(IV) CHLORIDE AND SOME PHENOLS AND NITROPHENOLS. Sarju Prasad and Suresh Kumar (Banaras Hindu Univ., Varanasi, India). J. Indian Chem. Soc., 40: 531-3(July 1963).

The preparation and properties of some addition and substitution compounds of $ThCl_4$ with phenols and nitrophenols were studied. The results show that one molecule of $ThCl_4$ reacts with two molecules of a monohydroxy- (except o- and m-cresols) and one molecule of di- or trihydroxy phenol and two chlorine atoms of $ThCl_4$ are displaced, yielding di- substitution products, HCl gas being eliminated. With o- and p-nitrophenols, the reaction is similar to that with monohydroxy phenols, the $-NO_2$ group remaining intact and only the OH group being affected. Structures of the resulting compounds are also discussed. (P.C.H.)

40807 CHEMISTRY OF THORIUM. PART V. AN ELECTROMETRIC STUDY ON THE QUANTITATIVE PRECIPITATION OF THORIUM AS NORMAL TELLURITE. Sarju Prasad and Suresh Kumar (Banaras Hindu Univ., Varanasi, India). J. Indian Chem. Soc., 40: 534-8(July 1963).

The results of a series of conductometric titrations of thorium(IV) against potassium tellurite with an overall concentration of 30-40% ethanol are reported. The possibility of carrying out direct as well as reverse titrations over a satisfactory range of thorium concentration was concluded and the effect of ethanol concentration was also studied, which, under cited conditions, lends support to the formation of thorium tellurite (molar ratio of Th : Te being 1 : 2). (auth)

40808 A KINETIC STUDY OF THE ISOTOPIC EXCHANGE OF INDIUM BETWEEN INDIUM ION AND ITS ETHYLENEDIAMINE-N,N,N′,N′-TETRA-ACETATE IN WATER. K. Saito and M. Tsuchimoto (Tokyo Univ.). J. Inorg. Nucl. Chem., 25: 1245-52(Oct. 1963).

Isotopic exchange of indium between the indium ion and its EDTA complex is immeasurably slow in neutral solution and very fast in strongly acid and basic solutions. The rate is measurable in the pH regions near 2 and 10, and the rate constant for exchange is independent of the concentration of uncomplexed indium and proportional to that of the complex. In basic media the rate constant is proportional to $[OH^-]^2$ with an Arrhenius activation energy of 25 kcal $mole^{-1}$. At pH 1 to 2 the rate constant is proportional to $[H^+]^3$ with an activation energy of 18 kcal $mole^{-1}$. The complex appears to be more inert than the corresponding gallium complex. (auth)

40809 THE REACTION BETWEEN URANYL NITRATE AND SODIUM TRIMETAPHOSPHATE. A. Indelli and G. Saglietto (Università, Ferrara, Italy). J. Inorg. Nucl. Chem., 25: 1259-61(Oct. 1963).

The precipitate formed when sodium trimetaphosphate and uranyl nitrate solutions are mixed was identified as uranyl triphosphate by determination of uranium and phosphorous contents, chromatographic analysis, and by x-ray diffraction. The reaction rate was followed by acid–base titrations and by a polarographic method. The rate is dependent upon the hydrogen ion concentration, and at least two mechanisms appear to be responsible for the reaction. The results may be fitted to rate equation based upon the participation of the species UO_2^{2+} and $U_2O_5H^{3+}$. (auth)

40810 THERMAL DECOMPOSITION OF PLUTONIUM OXALATES. G. S. Rao, M. S. Subramanian, and G. A. Welch (Atomic Energy Establishment, Trombay, India). J. Inorg. Nucl. Chem., 25: 1293-5(Oct. 1963).

Studies on the thermogravimetric decomposition of plutonium(IV) oxalate hexahydrate in air showed a definite intermediate of trivalent Pu in the temperature range of 250–280 C, which was characterized by chemical analysis as an oxalate-carbonate. Namely, $Pu(C_2O_4)(CO_3)_{0.5}$ requires Pu 66.9, $C_2O_4^{2-}$ 24.7, CO_3^{2-} 8.4%; found Pu 65.4, $C_2O_4^{2-}$ 25.3, CO_3^{2-} 8.6%. Plutonium(III) oxalate precipitated from aqueous solution was found to crystallize with 10 molecules of water. On heating on a thermobalance in air, hydrates containing 9, 2, and 1 molecule of water of crystallization were obtained, while in an argon atmosphere the anhydrous oxalate was also formed. There was no indication of intermediate compounds between the anhydrous oxalate and the final product plutonium dioxide. (P.C.H.)

40811 THE IMPORTANCE OF ACTIVE SURFACE AREA IN THE CARBON–OXYGEN REACTION. N. R. Laine, F. J. Vastola, and P. L. Walker, Jr. (Pennsylvania State Univ., University Park). J. Phys. Chem., 67: 2030-4 (Oct. 1963).

Graphon, a highly graphitized carbon black, was oxidized to seven levels of burn-off between zero and 35%. The active surface area of the oxidized samples was determined by measuring the coverage of the surface with oxygen complex upon exposure of the samples to O_2 at 300° for 24 hr. After removal of the complex, the Graphon samples were subsequently treated with additional O_2. The amount of oxygen complex formed on the surface during reaction could be followed by a material balance and at the end of a run by outgassing. From the data, unoccupied active surface areas were calculated. Rate constants for O_2 depletion and product formation, calculated on the basis of unoccupied active area, were essentially constant over most of the burn-off range studied. On the other hand, rate constants, calculated on the basis of BET surface area, showed a considerable increase with burn-off. (auth)

40812 THE INTRINSIC GEOMETRICAL AND FLOW PROPERTIES OF POWDER PACKS. Andre J. de Bethune (Boston Coll., Chesnut Hill, Mass.) and Robert L. Rowell. J. Phys. Chem., 67: 2065-71(Oct. 1963).

Four experimentally measurable properties of a powder pack, the specific surface (internal pore wall surface), porosity (internal pore volume, Knudsen flow, and Poiseuille flow, can be used to define four independent pore radii: the Adzumi radius, Knudsen radius, hydraulic radius, and sigma radius. For homogeneous pore size distributions, the four pore radii tend to be approximately equal; for inhomogeneous pore size distributions, they become grossly unequal. Pore size inhomogeneities may lead to a struc-

ture in which the large pores contribute predominantly to the flow properties, while the surface area is determined principally by the smaller pores. This leads to a marked elevation of the flow (Adzumi and Knudsen) pore radii over the geometrical (hydraulic and sigma) pore radii and to shape factors greater than unity. Of various pore size distributions considered the double broad gaussian appears to be the most realistic. Equations are set up that permit the calculation, from experimental data, of the mean pore size and the pore population density of each one of the two gaussian terms. The model can be used as a basis for testing other properties of powder packs. (auth)

40813 THE COMPOSITION RANGE, DECOMPOSITION PRESSURE, AND THERMODYNAMIC STABILITY OF Nb_3Ge. John H. Carpenter (Univ. of California, Liwermore). J. Phys. Chem., 67: 2141-4(Oct. 1963). (UCRL-7157(Rev.1))

The phase of ideal composition Nb_3Ge was found to have a solid solution range extending from $NbGe_{0.22\pm0.01}$ to $NbGe_{0.15\pm0.01}$ at 1600° as determined from x-ray diffraction lattice parameter studies. The decomposition pressure of germanium over Nb_3Ge was determined by the Knudsen effusion method. Surface depletion of the vapor pressure sample was encountered, but equilibrium decomposition pressures were derived from the data. The enthalpy of the decomposition reaction, 6.67 $NbGe_{0.15}(s)$ = 6.67 Nb(s) + Ge(g) at 298°K, is 116.6 ± 3 kcal. (auth)

40814 THE DECOMPOSITION PRESSURES OF α- AND β-Nb_5Ge_3 AND THE THERMODYNAMIC STABILITY OF $NbGe_2$. John H. Carpenter and Alan W. Searcy (Univ. of California, Berkeley and Purdue Univ., Lafayette, Ind.). J. Phys. Chem., 67: 2144-7(Oct. 1963). (UCRL-7158(Rev. 1))

The decomposition pressures of α-$Nb_5Ge_3(NbGe_{0.54})$ and β-$Nb_5Ge_3(NbGe_{0.67})$ were measured by the Knudsen effusion method. For the decomposition of α-Nb_5Ge_3 by the reaction, 3.12$NbGe_{0.54}(s)$ = 3.12$NbGe_{0.22}(s)$ + Ge(g), H°_{298} = 122.3 ± 3 kcal. The apparent decomposition pressure of β-Nb_5Ge_3 was found to vary with effusion orifice area. The mechanism of evaporation is discussed and the equilibrium decomposition pressure of β-Nb_5Ge_3 calculated. For the reaction 7.69$NbGe_{0.67}(s)$ = 7.69$NbGe_{0.54}(s)$ + Ge(g), the equilibrium pressure is $2.44 \pm 0.10 \times 10^{-6}$ atm at 1757°K. Decomposition data for α- and β-Nb_5Ge_3 and $NbGe_2$ give the following enthalpies of formation at 298°K: 1/0.54$NbGe_{0.54}$, −27.1 ± 2 kcal; 1/0.67$NbGe_{0.67}$, −22.9 ± 2 kcal; ½$NbGe_2$, −10.4 ± 2 kcal. (auth)

40815 ELECTROMOTIVE FORCE MEASUREMENTS IN MOLTEN DIVALENT METAL-METAL HALIDE SOLUTIONS. L. E. Topol (Atomics International, Canoga Park, Calif.). J. Phys. Chem., 67: 2222-5(Oct. 1963).

Potentiometric studies on concentration cells of the type C, $M(N_1), MX_2(1-N_1)\|MX_2(1-N_2), M(N_2)$, C, where M represents Hg, Cd, Pb, and Zn, MX_2 the halide, and N denotes the metal mole fraction, were made at various temperatures. Slopes of plots of the log metal concentration vs emf yielded apparent Nernst n-values of 2 for Hg−$HgCl_2$ at 300°C and for Cd−$CdCl_2$ at 580°C. For Pb−PbI_2 apparent Nernst n-values of about 2.2−2.3 were found at 585 and 693°C; for Pb−$PbCl_2$ the low metal solubility made detection of an n-value difficult but a value of 2 appeared probable. No constant emf values were obtained in Zn−$ZnCl_2$ melts at 658 and 695°C. The above n-values of 2 indicate a two-electron reaction at the electrode and are consistent with the existence of metal atoms M or cation dimers M_2^{+2}. No evidence for the monomer ion M^+ was observed. (auth)

40816 HIGH-TEMPERATURE THERMODYNAMIC FUNCTIONS FOR ZIRCONIUM AND UNSATURATED ZIRCONIUM HYDRIDES. Thomas B. Douglas. J. Res. Natl. Bur. Std., 67A: 403-26(Sept.-Oct. 1963).

Giving greatest weight to the experimentally measured highest decomposition pressures and the enthalpies in one-phase fields, thermodynamically interconsistent integral and differential enthalpies (heat contents), heat capacities, entropies, and Gibbs free energies were derived for the crystalline one- and two-phase fields of the zirconium-hydrogen system for all stoichiometric compositions from Zr to $ZrH_{1.25}$ and over the temperature range 298.15 to 1,200°K. The properties were derived in analytical form, and in most cases are represented by numerical equations, with tabulation for zirconium and H/Zr atom ratios of 0.25, 0.50, 0.57, 0.75, 1.00, and 1.25. Most of the unique phase-field boundaries, which are consistent with the derived properties, were located and are compared with those previously reported. In the Zr−H system the enthalpies are shown to relate certain properties at different compositions as well as at different temperatures. Some of the various data show good interconsistency, while others reveal discrepancies and are discussed critically. (auth)

40817 PREPARATION OF URANIUM TARGETS BY ELECTROCAPILLARY METHOD. E. G. Dermendzhiev and M. K. Delchev (Inst. of Physics, Bulgarian Academy of Sciences, Sofia). Pribory i Tekhn. Eksperim., No. 4, 170-3(July-Aug. 1963). (In Russian)

The preparation of thin sheets of uranium nitrate by the electrocapillary method is described. Data on the structure of these sheets is presented. It is determined that the sheets become more close-grained and uniform with decreased voltage and concentration of the solution. (tr-auth)

40818 SODIUM PERXENATE HEXAHYDRATE. Allan Zalkin, J. D. Forrester, David H. Templeton, Stanley M. Williamson, and Charles W. Koch (Univ. of California, Berkeley). Science, 142: 501-2(Oct. 25, 1963). (UCRL-11010)

Sodium perxenate hexahydrate ($Na_4XeO_6 \cdot 6H_2O$) was identified from study of its crystal structure by x-ray diffraction. The perxenate ion (XeO_6^{-4}) has the shape of a regular octahedron with the Xe−O bond distance 1.84 Å. (auth)

40819 CONTRIBUTION TO THE COMPLEX CHEMISTRY OF TECHNETIUM. II. PREPARATION AND PROPERTIES OF POTASSIUM−CYANOTECHNETATE(I). K. Schwochau and W. Herr (Universität, Cologne and Kernforschungsanlage, Julich, Ger.). Z. Anorg. Allgem. Chem., 319: 148-58(1962). (Jul-105-RC). (In German)

Cyanotechnetate(I) was prepared by reduction of $Tc^{99}O_4^-$ or $(Tc^{99}(OH)_3(CN)_4)^{3-}$ with potassium amalgam in the presence of KCN. The potassium salt was isolated in the form of bright olive-green, face-centered-cubic crystals. It is isotopic with $K_5(Mn(CN)_6)$ and $K_5(Re(CN)_6)$. In addition, the absorption spectra of these three complex cyanides are very similar to each other; therefore, the analogous formula $K_5(Tc(CN)_6)$ was attributed to the potassium cyanotechnetate(I). The lattice constants of the complex salts were determined to be 11.890 ± 0.002 A for the cyanomanganate, 12.106 ± 0.001 A for the cyanotechnetate, and 12.033 ± 0.001 A for the cyanorhenate. The fact that the lattice constant of $K_5(Re(CN)_6)$ is smaller than that of $K_5(Tc(CN)_6)$ is explained, in agreement with the oxidation stability of the complexes, by the deep penetration of the electron shells of the central Re atom and the CN ligands. (auth)

40820 ON THE MIXED SYSTEMS OF ALKALI AND ALKALINE EARTH FLUORIDES WITH URANIUM COMPOUNDS. Kurt Recker (Universität, Bonn.). Z. Krist., 118: 161-85(June 1963). (In German)

A survey is given of the results of extended investigations into certain systems of anomalous mixed crystals between uranium compounds and fluorides of the alkalis and alkaline earths. The systems in question are as follows: $NaF-Na_2U_2O_7$, $LiF-Li_2UO_4$, $KF-K_2UO_4$, $NaF-UO_2(OH)_2$, CaF_2-CaUO_4, CaF_2-UO_2. These mixed crystals were subjected to examination under the polarizing microscope, by x rays, and by spectral photometry. In numerous cases it was possible to deduce the mechanism of intergrowth and this can serve as a base on which a later discussion of the absorption and luminescence phenomena of these systems can be founded. (auth)

40821 NEUTRONOGRAPHIC STUDIES OF SOLID OXYGEN. R. A. Alikhanov (Inst. of Problems in Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 812-14(Sept. 1963). (In Russian)

Neutronographic studies were made of solid oxygen in order to determine the feasibility of using neutron diffraction in determining crystalline and magnetic properties of oxygen at low temperatures. (R.V.J.)

40822 KATALITICHESKIE SVOISTVA REDKIKH I REDKOZEMEL'NYKH ELEMENTOV. (Catalytic Properties of Rare Elements and Rare Earths). T. T. Bakumenko. Kiev, Publishing House of the Academy of Sciences, 1963. 100p.

Catalytic properties of rare earths are reviewed and references are given for each group according to the periodic table. (R.V.J.)

40823 REFRACTORY SULPHIDES OF URANIUM AND THORIUM. P. D. Shalek and J. H. Handwerk. p.1-10 of "Special Ceramics." London and New York, Academic Press, 1962.

Uranium and thorium monosulfides were investigated for their potential as nuclear fuels. Synthesis, fabrication, and evaluation of properties are covered in some detail for US, and to a lesser extent for ThS. Uranium monosulfide could be synthesized to better than 99.5% purity and sintered to 92% theoretical density in argon. Sintering in vacuo was by a different mechanism and proved more difficult. Thorium monosulfide sintered to near theoretical density in vacuo owing to a higher impurity content. Some solid solutions were made. The monosulfides were found to be quite metallic in appearance, machinability, and electrical conductivity. Other properties such as volatility, oxidation resistance, compatibility, melting-point, and thermal conductivity were also investigated. (auth)

40824 SURVEY OF THE SPECTRA OF THE DIVALENT RARE EARTH IONS IN CUBIC CRYSTALS. Donald S. McClure (Univ. of Chicago) and Zoltan Kiss. 24p. (CONF-18-2)

From Polytechnic Institute of Brooklyn Symposium on Optical Masers, New York, Apr. 1963.

The rare earth ions may exist in the divalent state in suitable host crystals such as CaF_2. All of the trivalent ions from Ce to Yb (and probably also La) are reduced in situ to the divalent state in CaF_2 by gamma irradiation. The spectra of most of these ions show that the ground and first few excited states derive from f^n configurations, but the weak absorption due to these is masked at higher energies by strong broad bands of the parity-permitted $f^n \rightarrow f^{n-1}d$ transitions. The excitation energy of these spectra were calculated in a first approximation as the energy difference between the "Hund Rule" single determinant states of the configurations $f^{n-1}d$ and f^n. This procedure satisfactorily accounts for the variations in the excitation energy in passing from one ion to the next in the series with the exception of Gd^{2+}, Ce^{2+}, and Tb^{2+}. Gd^{2+} probably has f^7d for its ground configuration, while Ce^{2+} and Tb^{2+} are borderline cases. The spectral structure probably arises chiefly from the crystal field splitting of the d-orbital, since each ion in CaF_2 has a similar spectrum, and the spectra change drastically in sites of other than cubic symmetry. (auth)

40825 A METHOD FOR STUDYING THE CHEMISORPTION AND EXCHANGE OF GASES ON SURFACES. Y. L. Sandler and W. M. Hickam (Westinghouse Research Labs., Pittsburgh). 14p. (CONF-74-21)

From 11th Annual Conference on Mass Spectrometry and Allied Topics, San Francisco, May 1963.

A mass-spectrometric method is discussed that makes it possible to obtain a detailed picture of chemisorption and exchange processes proceeding when a gas is adsorbed on a surface. Application of the method to the silver-oxygen system is described. O_2^{16} + neon is preadsorbed on the silver; O_2^{18} + argon is then allowed to react with the system. The inert gases are used in excess. A complete analysis of the concentration changes in the gas phase and adsorbed phase is made as a function of time without reference to adsorption isotherms. The information obtained on the adsorbed phase and other applications of the method are briefly discussed. (auth)

40826 PROCESS FOR THE REDUCTION OF ZIRCONIUM AND HAFNIUM-TETRACHLORIDE WITH LIQUID MAGNESIUM. (to Deutsche Gold-und Silber-Scheideanstalt Vormals Roessler). British Patent 938,969. Oct. 9, 1963. Priority date May 18, 1960, Germany.

A process for the reduction of zirconium and hafnium tetrachloride with liquid magnesium to form metallic zirconium and hafnium is presented. The reduction reaction takes place at the phase boundary between a melt of magnesium and a melt of halogen zirconate or halogen hafnate. The formation of the halogen zirconate or halogen hafnate is carried out separately from the reduction of the tetravalent zirconium or hafnium to metal. (C.E.S.)

40827 IMPROVEMENTS IN OR RELATING TO METHODS OF TREATING CARBONS AND INDUSTRIAL GRAPHITE FOR THE CHEMICAL INDUSTRY. (to Societe Le Carbone-Lorraine). British Patent 939,215. Oct. 9, 1963. Priority date Aug. 5, 1959, France.

A method for treating carbons and industrial graphites is presented in which the materials are impregnated by a resol formo-phenolic resin whose resistance to chemical agents is increased by condensation and polymerization in situ with furfuryl alcohol or furfuryl aldehyde. The carbons and graphites are carbonized at a temperature that progressively increases by 3°C per hour to 1200°C. The carbons and graphites are packed with absorbent cotton, placed in coal dust or finely ground coke, and baked. The end products are very resistant to high temperatures and to corrosion by chemical agents and are impervious to gases and liquids. (C.E.S.)

40828 URANIUM OXIDE SOLS AND METHODS FOR THEIR PREPARATION. (to W. R. Grace and Co.). French Patent 1,279,654. Nov. 13, 1961. Priority date Jan. 8, 1960, United States.

An aqueous UCl_4 solution is hydrolyzed at 60–100°C and then electrodialyzed at 15–35°C. The colloidal particles of the resulting sol are coated with SiO_2 by mixing the sol with a SiO_2 sol. Finally the pH is adjusted at 7–10 and the

sol deionized with ion exchange resins. The sol, having a particle size of 30–120 Å and a concentration up to 17 wt %, is said to be hydrothermally stable and to find application as a reactor fuel. (NPO)

40829 THORIUM OXIDE–URANIUM OXIDE SOLS AND METHODS FOR THEIR PREPARATION. (to W. R. Grace and Co.). French Patent 1,279,655. Nov. 13, 1961. Priority date Jan. 8, 1960, United States.

The preparation of ThO_2/UO_2 sols for use as fuel in homogeneous reactors is reported. An aqueous $ThCl_4$–UCl_4-solution is hydrolyzed at 60–100°C and freed from the anions by electrodialysis at 15–35°C. The resulting sol is mixed with a SiO_2 sol, the pH adjusted, and the mixture deionized with ion exchange resins. The size of the colloidal particles in the resulting sol is 200–1125 Å, the thickness of the stabilizing SiO_2 film 70–150 Å, while the pH = 7–10. The concentration of the sol can be increased by evaporation to 50 wt %. (NPO)

40830 CATALYST FOR RECOMBINING HYDROGEN AND OXYGEN FROM THORIUM OXIDE SLURRIES. (to U. S. Atomic Energy Commission). French Patent 1,284,927. Jan. 8, 1962. Priority date Mar. 30, 1960, United States.

A recombination catalyst is prepared by refluxing ThO_2, obtained by calcination of Th oxalate, in an aqueous Pd nitrate solution containing at least 0.05 g Pd per g ThO_2 until a sol is formed, followed by treatment of the sol with hydrogen until the sol is completely converted into a flocculated suspension. The recuperated solid is added to ThO_2 slurry blankets, a convenient Pd/ThO_2 ratio in the blanket being 1:1000–1:10000. (NPO)

40831 METHOD FOR PRODUCING ZIRCONIUM DIOXIDE. Irvon Charles Klimaszewski (to Columbia National Corp.). German Patent 1,150,961. July 4, 1963. Priority date June 12, 1959, United States.

A method is described for producing zirconium dioxide of a bulk weight of 800 kg/m^3 by expelling nitrogen oxides. Source material for the method is a thixotropic zirconium nitrate that is produced by heating a watery suspension of solid zirconium nitrate and by separating the water so that a paste is obtained. The thixotropic mixture of zirconium nitrate and water is calcined. (Gmelin Inst.)

40832 METHOD FOR PRODUCING THE PENTACHLORIDES OF NIOBIUM AND/OR TANTALUM. Charles Alexander Sutherland (to Nova Beaucage Mines Ltd.). German Patent 1,152,094. Aug. 1, 1963. Filed Feb. 16, 1960.

A method is described for producing the pentachlorides of niobium and/or tantalum by heating an oxide containing source material and chlorinating the obtained carbide. The source material is ores or ore concentrates of pyrochlor, colombite, and tantalite. The method comprises the steps of igniting a dry mixture containing niobium and/or tantalum in form of oxides, aluminium powder in an stoichiometric amount, and a surplus of carbon within an inert gas atmosphere, of heating it to more than 1600°C, and of chlorinating the obtained niobium and/or tantalum carbide to obtain the respective pentachlorides. (Gmelin Inst.)

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Refer also to abstract 40428.

40833 (ARL-63-27) APPLICATIONS OF LOCALIZED PERTURBATION TECHNIQUE. Technical Note No. 75. M. Asgar Ali and Richard F. Wood (Uppsala Univ.). Apr. 1, 1962. Contract AF61(052)-351. 56p. (AD-296763)

The localized perturbation technique for conjugated systems is applied within the framework of Hückel theory by using the inverse of cyclic matrices in closed analytical form in terms of Chebyshev polynomials by the method of Löwdin, Pauncz and de Heer. It is shown that by this approach, the exact energy levels and eigenfunctions of perturbed conjugated systems can be obtained by a simple non-iterative method for simple perturbations and by a second order iteration process for complicated perturbations, reducing the numerical "size" of the problem considerably. Possible applications of this technique in other related fields are discussed. (auth)

40834 (CEA-2221) EFFETS ISOTOPIQUES DU DEUTÉRIUM ATTACHÉS A DES MÉCANISMES UNIMOLÉCULAIRES ET CONCERTÉS. CAS DES DEUTERO 1 CHLORO 2 ALCOOLS. (Deuterium Isotopic Effects Connected with Unimolecular and Concerted Mechanisms. The Case of 1-Deutero-2-Chloro Alcohols). Claude Jambon (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 46p.

Thesis submitted to Universite, Paris.

After a bibliographic analysis of the probable causes of isotopic effects and their comparison, with the simplifications provided by the athermal model, a discussion of the isotopic effect of deuterium in organic molecules in terms of structural influences is presented, showing the important role of the C-D bond length which is shorter than the C-H bond length, and of the D atom's Van der Waals radius, shorter than that of the H atom. Kinetic measurements were carried out on some reactions involving the mechanisms proposed: unimolecular ionizations and halogen concentrates. The structural models chosen are: 2-chloro-cyclohexanols cis and trans 1-H and 2-D; 2-chloro-cyclopentanols cis trans 1-H and 1-D; 1-phenyl-1-chloro-2-propanol threo 2-H and 2-D. (auth)

40835 A SIMPLE METHOD FOR PREPARATION OF C^{14}-LABELED DL-β-HYDROXYBUTYRIC ACID. Vishwa Nath Singh and Soma Kumar (Georgetown Univ., Washington, D. C.). Anal. Biochem., 6: 374-80(Oct. 1963).

A simple method for preparing C^{14}-labeled β-hydroxybutyric acid, based on the reduction of acetoacetate with potassium borohydride, is described. The yield of β-hydroxybutyric acid with respect to ethyl acetoacetate was 75 to 80%. By starting with the suitably labeled ethyl acetoacetate, DL-β-hydroxybutyric acid may be prepared containing the radioactive carbon in any position desired. It is suggested that the tritiated compound should be possible to prepare using tritiated borohydride. (H.M.G.)

40836 FORMALDEHYDE RESINS. LXXVII. THE SYNTHESIS OF SOME ANTHRACENE DERIVATIVES AS A WAVELENGTH SHIFTER OF A PLASTIC SCINTILLATOR. Minoru Imoto and Tadao Nakaya (Osaka City Univ.). Bull. Chem. Soc. Japan, 36: 785-8(July 1963). (In English)

Three anthracene derivatives, 9,10-di-m-xylyl-anthracene (II), 9,10-bis(4-methylbenzyl)anthracene (III), and 9,10-bis(2,3.5,6-tetramethylbenzyl)anthracene (IV), were synthesized and their ultraviolet and fluorescence spectra measured. The shift of the spectrum to the longer wavelength by the presence of methylene groups between anthracene and benzene rings may be explained in terms of direct conjugation between three rings. According to the spectra, the compounds are believed to be better second solutes of the plastic scintillator. (auth)

40837 CROSS LINKING OF POLYETHYLENES BY BENZOYL PEROXIDE. III. FORMATION OF CROSS COMPOUNDS. R. Rado and M. Lazar. Chem. Zvesti, 15: 191-7(1961). (In Slovak)

Cross compounds in polyethylenes occur from the effect of benzoyl peroxide in the same manner as by ionizing radiation or uv light, through the recombination of polymer radicals. The compounds between the macromolecules represent the resultant of a chain process of the decomposition of benzoyl peroxide in polyethylenes. The quantitative expression of the velocity of the appearance of cross compounds depends on the analysis of the interaction velocity of the polymer radicals on the basis of the kinetic constants of the peroxide decomposition and the transfer of the primary radical to the polymer. (tr-auth)

40838 CONVERSIONS IN POLYOLEFINS INITIATED BY PEROXIDES. Rudolf Rado. Chem. Zvesti, 16: 44-55 (1962). (In Slovak)

Each regularity observed in peroxide-induced conversions in polyolefins was treated comprehensively. The method used for the study of the processes occurring and the principles of the kinetic analyses used in the identification of the mechanism of these reactions were described. From the observations of the conversions in polyethylene, polypropylene, and polyisobutylene, the chemism scheme of the reaction investigated was derived, and its elementary stages from the decomposition of the peroxide over the transfer up to the reactions terminating the radical processes were interpreted. The conversions as such in the macromolecule chains were evaluated both from the standpoint of the structure of the active group of polymer radicals and on the basis of the steric assumptions for this interaction. The possibilities of an adjustable regulation of the destruction process were mentioned. (tr-auth)

40839 DEUTERIUM EXCHANGE BETWEEN PHENYLPHOSPHONOUS ACID AND WATER. J. Reuben, David Samuel, and Brian L. Silver (Weizmann Inst. of Science, Rehovoth, Israel). J. Am. Chem. Soc., 85: 3093-6(Oct. 20, 1963).

The phosphorus-bonded hydrogen of phenylphosphonous acid undergoes isotopic exchange with deuterium in both acidified ethanol–water mixtures and in aqueous alkaline solution. The kinetics of the acid- and base-catalyzed exchange was studied utilizing nuclear magnetic resonance spectroscopy. Oxygen-18 exchange between phenylphosphonous acid and solvent water was not detectable under the conditions in which hydrogen exchange was measured. (auth)

40840 THE STABILITIES OF THE ALKALINE EARTH CHELATES OF SOME POLYAMINOPOLYCARBOXYLIC ACIDS. J. H. Grimes, A. J. Huggard, and S. P. Wilford (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Inorg. Nucl. Chem., 25: 1225-38(Oct. 1963).

Interactions of the alkaline earth metals with some polyaminopolycarboxylic acids were investigated by the potentiometric titration method for aqueous solutions of ionic strength approximately 0.1 at 30°. Metal chelate formation constants were calculated, and the effects of ligand structure on chelate stability are discussed. (auth)

40841 WATER VAPOR SORPTION OF MUCOPOLYSACCHARIDES. Frederick A. Bettelheim and Sanford H. Ehrlich (Adelphi Coll., Garden City, N. Y.). J. Phys. Chem., 67: 1948-53(Oct. 1963).

Water and deuterated water vapor sorption isotherms were obtained on calcium salts of chondroitin sulfates A, B, and C, as well as on heparin. The sorptive capacity and extent of hysteresis were analyzed and correlated with the thermodynamic functions of sorption and with the BET monolayer. Calcium chondroitin sulfate A has the largest interchain interaction in the solid state and its water sorptive capacity is the smallest among these polyelectrolytes. Calcium chondroitin sulfate C, on the other hand, has almost free swelling properties with minimal hysteresis effect. The water sorptive and retention capacities were correlated with molecular structure. (auth)

40842 A STUDY OF THE ADSORPTION AND DECOMPOSITION OF HYDROCARBONS ON CLEAN IRIDIUM SURFACES. Richard W. Roberts (General Electric Research Lab., Schenectady, N. Y.). J. Phys. Chem., 67: 2035-8 (Oct. 1963).

The adsorption and decomposition of methane, ethane, and ethylene on iridium films prepared under ultrahigh vacuum was investigated. Methane adsorbed on films at 27 and 100° but did not decompose. Ethane decomposed on iridium (27°) to hydrogen and methane and on iridium (100°) to methane. The addition of oxygen to a clean iridium film greatly inhibited the subsequent decomposition of ethane to methane. Ethylene underwent self-hydrogenation to ethane on iridium (27 and 100°) and methane also was produced. The roughness factor of the iridium films was about seven. (auth)

40843 PREPARATION OF VERY HIGH SPECIFIC ACTIVITY IODODEOXYURIDINE; IODOURIDINE AND IODOURACIL, LABELLED WITH IODINE-125, -131 OR -132. D. J. Silvester and N. D. White (Hammersmith Hospital, London). Nature, 200: 65-6(Oct. 5, 1963).

As part of a study of uses of radioactive substance for brain tumor localization, I^{131}-5-iododeoxyuridine was prepared in a solution suitable for injection into rats. Deoxyuridine, nitric acid, chloroform, and carrier free I^{131}-iodide solution were refluxed together, and the labeled iododeoxyuridine was separated on an anion exchange column. I^{131}-5-iodouridine and I^{131}-5-iodouracil were prepared in the same manner. (M.C.G.)

40844 PREPARATION OF THREAD-LIKE SCINTILLATORS. V. G. Kokoylin. Pribory i Tekhn. Eksperim., No. 4, 183-4(July-Aug. 1963). (In Russian)

A simple method is described for the preparation of thread-like scintillators of 0.2–3 mm diameter with indefinite length and luminosity from polystyrenes. (tr-auth)

40845 THE PROBLEM OF DEFECTS IN RELATION TO THE OPTICAL PROPERTIES OF ORGANIC MOLECULAR CRYSTALS. Robin M. Hochstrasser (Florida State Univ., Tallahassee). Radiation Res., 20: 107-17(Sept. 1963).

The influence of crystal imperfections on exciton luminescence spectra was examined with the aim of correlating experimental phenomena with possible theoretical models. No specific nature was ascribed to defect sites in molecular crystals other than that these excited states are not in exact resonance with the surrounding lattice states. It was suggested that the measurement of temperature-dependent parameters will possibly provide important information regarding the thermal quasi-equilibrium over the various crystal states. The problem of self-trapping of excitons and the perturbation of exciton states by point defects were not treated, but this omission was not intended to suggest that such mechanisms are absent or that known spectra might not already manifest these phenomena in addition to the particular aspects discussed. (auth)

40846 THE SYMMETRY AND SPECTRAL PROPERTIES OF HELICAL POLYNUCLEOTIDES. William Rhodes (Florida State Univ., Tallahassee). Radiation Res., 20: 120-32(Sept. 1963).

The results of applying the theory of space groups to a model double-stranded helix were used to describe the electronic states (exciton states) of helical polynucleotides. The role of symmetry in determining the nature of the $\pi\pi^*$ and $n\pi^*$ exciton bands of the helix is considered. Selection rules are given for electric-dipole transition between the ground state and exciton bands and for the mixing of zeroth-order states which results from interactions within the helix. Perturbation theory is used to determine quantitatively the effect of $\pi\pi^*$ mixing on the intensity of an $n \rightarrow \pi^*$ transition which presumably is present on the low-energy side of the 2600-A $\pi \rightarrow \pi^*$ absorption band. Since $\pi\pi^* - n\pi^*$ mixing to first order is zero, it is necessary to use third-order perturbation theory. Results show that on formation of the helix such mixing may be sufficient to account for the observed increase in intensity in the region 2800 to 2900 A; however, the stolen intensity should appear as a perpendicularly polarized component. Other kinds of interaction which may account for the observed intensity increase are discussed. (auth)

40847 THE EXCITON CONTRIBUTION TO THE OPTICAL ROTATION OF POLYMERS. Ignacio Tinoco, Jr. (Univ. of California, Berkeley). Radiation Res., 20: 133-9 (Sept. 1963).

The optical properties of a polymer are discussed. In particular, use of zero-order exciton wave functions to obtain expressions for the dipole strength and the rotational strength of each exciton level in the polymer is described. For any finite array one can diagonalize the perturbation energy matrix to obtain the correct first-order energies and zero-order wave functions. These wave functions can then be used to calculate any optical property to zero order. For an infinite array the use of re-entrant boundary conditions is discussed. Although this approximation is valid for absorption, it is not valid for optical rotation. As examples, a dimer and an infinite helix are treated. (auth)

40848 THE BIOCHEMICAL PREPARATION OF l-CYSTEIN, l-CYSTINE AND l-CYSTEIC ACID CONTAINING ISOTOPIC SULPHUR AND OR ISOTOPIC α-HYDROGEN ATOMS. Francois Chapeville and Pierre Fromageot (to Commissariat à l'Energie Atomique). British Patent 939,650. Oct. 16, 1963. Priority date Feb. 3, 1959, France.

A biochemical process was developed for the preparation of l-cysteine, l-cystine, or l-cysteic acid containing isotopically different sulfur and/or isotopic α-hydrogen atoms. Pure l-cysteine is reacted with one or more reactants labeled by sulfur or hydrogen in aqueous solution between pH 5 and 11 and between 0 and 55°C. A biochemical catalyst, an enzyme present in the yolk-sac of eggs of birds or reptiles in embryo, was used. (M.C.G.)

Radiation Chemistry and Radiochemistry

40849 (AEET/CD/14) RECOIL EFFECTS OF COBALT-58 RESULTING FROM (γ,n) REACTION IN COBALT COMPLEXES. Amar Nath and An. N. Nesmeyanov (India. Atomic Energy Establishment, Trombay). 1963. 25p.

The recoil effects of Co^{58} resulting from Co^{59} (γ,n) Co^{58} reaction, were studied in several cobalt chelates. The pattern of thermal annealing in (γ,n) reactions was found to be very similar to that obtained for (n,γ) reactions, despite the very large difference in recoil energies. The experimental data were examined in the light of existing models and concepts, and a model is proposed for stabilization of the recoil atom in the form of metastable species, which possess well-defined configurational and/or electronic defects. (auth)

40850 (AGN-AN-1013) HYDRAZINE PROCESS DEVELOPMENT. Interim Technical Engineering Report, May through July 1963. J. C. Whipple, L. G. Carpenter, R. I. Miller, R. L. Pearson, and F. R. Standerfer, H. J. Snyder (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AF33(600)-42996. 140p. (AD-415041)

The primary goal of this program is to develop, design, construct, and operate a continuous in-reactor hydrazine production loop based on the fissiochemical process approach. This ninth quarterly progress report discusses the product decontamination apparatus to be installed in the CPP multicurie cell; the successful operation of the component test loop; the testing and shipment of all major loop and support equipment and the beginning of their installation at the MTR; techniques for increasing equilibrium hydrazine concentration; and the mechanisms of hydrazine formation. (auth)

40851 (NP-13199) ELECTRON SPIN RESONANCE OF AN X-IRRADIATED SINGLE CRYSTAL OF 1,4-DIKETOPIPERAZINE. Technical Report, Series A, No. 27. Ichiro Miyagawa (Tokyo Univ. Inst. for Solid State Physics). Oct. 1961. 17p.

Electron spin resonance absorptions of x-irradiated single crystals of 1,4-diketopiperazine and its deuterium-exchanged compound were observed at room temperature at 9 kMc/sec. From the analysis of the hyperfine structure which depends on crystal orientation, a chemical structure with a free electron on one of the reduced carbons was deduced for the structure of the produced free radical. The separation for the · CH hydrogen was in the range of 10 gauss to 27 gauss. Its principal elements were the same as those of the radical from N-acetylglycine in magnitude as well as in direction within the experimental error. The separations for the CH_2 hydrogens and the NH hydrogens were in the ranges of 8.5 gauss to 11 gauss and 0 to 4 gauss, respectively. From the above two separations, the spin density on the CH_2 carbon atom was concluded to be unexpectedly large, probably as large as 0.3. (auth)

40852 (NP-13229) CHEMISCHE REAKTIONEN ALS FOLGE DES P(n,γ)-PROZESSES IN PHOSPHORTRICHLORID. (Chemical Reactions Following the P(n,γ) Processes in Phosphorus Trichloride (thesis)). Horst Drawe (Berlin. Technische Universität). 1963. 80p.

When phosphorus trichloride is irradiated with thermal neutrons in a reactor, the nuclear reaction $P^{31} + n \rightarrow P^{32} + \gamma$ takes place, in the course of which the phosphorus atoms are back scattered, driving them out of their chemical compounds. Nevertheless, a great part of the activity appears in the form of $P^{32}Cl_3$. It is shown that the portion of the primary retention, that is, the (n,γ) capture that does not lead to the dissociation of the hit molecule, amounts to only 0.2%. $P^{32}Cl_3$ was reformed essentially through reactions of the intermediate P^{32} atoms. As far as these reactions are thermal, for example, the chlorination by Cl atoms and PCl_2 radicals from the γ radiolysis of PCl_3, they can be inhibited by hydrocarbons in small concentrations.

In this way it was established that a large part (about 50%) of the retention occurs by the reaction of the hot P^{32} atoms with PCl_3. This reaction is retarded by hydrocarbons or rare gases only at high concentrations, at which these materials act as moderators for hot P^{32} atoms. The greatest part of the P^{32} activity, which, after irradiation, does not exist in the form of $P^{32}Cl_3$, is found in a reactive form of polymer phosphors. (tr-auth)

40853 (TID-18176) THE DETERMINATION OF ELECTRON-INDUCED CONTRIBUTIONS OF ION-MOLECULE REACTIONS IN BINARY MIXTURES. THE FORMATION OF N_2D^+. Dwight A. Hutchison (Argonne National Lab., Ill.), Aron Kuppermann (Illinois. Univ., Urbana. Noyes Lab. of Chemistry), and Louis G. Pobo (Argonne National Lab., Ill.). Dec. 1962. Contract W-31-109-eng-38. 26p. (UAC-7147)

Recent studies of ion–molecule reactions have been made which may be represented as $M_1^+ + M_2 \rightarrow S^+ + N$, where M_1^+ is the reactant ion, M_2 is the reactant neutral species, S^+ is the product secondary ion, and N is the product neutral species. It has been assumed in past work that either M_1 or M_2 carries the positive charge. Until recently, the possibility that the reaction $M_2 + M_2^+ \rightarrow S^+ + N$ occurs simultaneously with the one just mentioned, to form the same secondary ion S^+, has not been considered. It is shown that both reactions may occur simultaneously when gases are exposed to electron impact in the ion source of a mass spectrometer. A method is presented for the determination of the fraction of each reaction occurring at a given electron energy, and it is illustrated by experimental data taken for the formation of N_2D^+ in mixtures of N_2 and D_2 under electron impact. The theory of Gioumousis and Stevenson is in good agreement with this data. (auth)

40854 (TID-19494) MECHANISM OF ACTION OF IONIZING RADIATION ON RIBONUCLEASE (thesis). Dilip Kumar Ray (Yale Univ., New Haven). [1963]. Contract AT(30-1)-2653. 109p.

The enzyme, bovine pancreatic ribonuclease, was chosen as the material for study in an attempt to establish a mechanism of the action of ionizing radiation on protein. The inactivation of ribonuclease cannot be accounted for by any single effect. At a high level of irradiation, 48 Mrad, roughly 15% of the molecules showed aggregation as determined by gel filtration, even after oxidation of the irradiated enzyme with performic acid. The same technique showed that about 5% of the total color developed by reaction with ninhydrin was due to fragments smaller than tripeptides. The amount of large fragments contributing to uv light absorption was estimated at 6% of the total absorbance at 280 mμ. These are clear evidences that chemical change took place in the molecules on irradiation. The binding of p-mercuribenzoate and Ag to the irradiated enzyme was observed. Whether that is due to their reaction with sulfhydryl groups produced by irradiation or due to any nonspecific reaction occurring at secondary binding sites on the enzyme is uncertain. Sulfhydryl groups may be considered to be generated with only 26% efficiency at the maximum. The loss of disulfide bonds of the enzyme was not detected which indicates that the sulfhydryl group may originate from a methionine residue. Conformational changes in the enzyme were reflected by a shift in the absorption spectrum and the appearance of minima in the difference spectrum reminiscent of the denaturation blue shift observed in other situations. The abnormal tyrosines, at least two of them, were also shown to be normalized. The enzyme became readily susceptible to tryptic digestion suggesting an extensive loosening of its compact structure. These effects can be most likened to the phenomenon of denaturation known in protein chemistry. It is proposed that the disruption of hydrophobic bonds due to a radical or charge formation anywhere within the molecule can lead to a disorganization of the three-dimensional structure of the molecule which may then cause inactivation. The conformational change must be a consequence of a chemical modification at some point in the molecule. (auth)

40855 (TID-19512) PROGRESS REPORT [ON RADIATION CHEMISTRY], JULY 1, 1963–AUGUST 30, 1963. Lewis G. Bassett (Rensselaer Polytechnic Inst., Troy, N. Y.). Sept. 30, 1963. Contract AT(30-3)-321. 3p.

The emission spectra of purified Ne were observed to have Ne lines, $N_2^+(^2\Sigma^+)$, N_2 second positive system (weak), OH bands, CO_2 excited (weak), and some unidentified lines. Liquid N_2 cooling removes the OH bands and the CO_2 excited emission, while an electric field intensifies the N_2 second positive group, NO gamma system, and OH bands. The effects of added CO on the Ne spectra were studied at concentrations from 0.01 ppm to 1%. During the irradiation of small amounts of CO in Ne, a small quantity of white solid carbon suboxide polymer was formed near the source. The results indicate that excited CO may react with added CO: $CO^* + CO \rightarrow CO_2 + C$ or $\rightarrow C_2O + O$. The spectra of pure Xe and the effects of added CO were also studied. Irradiation of air–He–NO_2 showed a decrease in the NO_2 concentration, indicating that the reaction of N + NO_2 is faster than the reaction of N + O_2. (D.L.C.)

40856 (UCRL-10961) LUMINESCENCE OF CRYSTALLINE CELL-NUCLEAR CHEMICALS UNDER IONIZING RADIATION. Richard L. Lehman and Roger W. Wallace (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 8, 1963. Contract W-7405-eng-48. 62p. (CONF-2661-1)

From Symposium on Electronic Aspects of Biochemistry, Rouello, Italy, Sept. 1963.

An experimental study was made of the delayed phosphorescence and thermoluminescence properties of 34 separate cell-nuclear chemicals exposed as crystalline powders to cobalt-60 rays at 77°K. In addition, the luminescence of the nucleic acid bases and related compounds was studied under irradiation with intense heavy-ion and electron beams. Under electron bombardment, the effects of ambient gases at various pressures were examined at 77 and 295°K. The biological significance of these measurements is discussed. The thermoluminescence-glow peak location, temperature-widths, and yields are reported. The location in no case exceeded 180°K, and in most cases stood in the region 100 to 150°K. It was found that a given chemical may have several peaks, and similar chemicals may have glow peaks that differ in width, location, and intensity. Adenine and cytosine samples released 0.2 and 0.1%, respectively, of the absorbed gamma energy as thermoluminescence. In each case, the yields of molecular compounds that contained conjugated π-molecular orbitals approached these; other compounds such as lecithin had yields of the order of 10^{-7}. The activation enthalpies for thermoluminescence glows were examined in detail, and a new method for their determination based on phosphorescence decay at 77°K was used. For those substances exposed to the particle beams, the emission spectra and yields at 250 to 600 nm under various gas pressures are reported. Radiofluorescence energy yields up to 13% were measured for adenine at 77°K when the ambient oxygen gas pressure was 300 μ Hg. At 286°K the yield was 0.2%. Yields for the other nucleic acid bases were roughly $^1/_{10}$ of these. The emission spectra were found to be bell-

shaped bands in the region 350 to 540 nm with widths of about 100 nm. When adenine was exposed at 77°K in the presence of >100 μ Hg of gas, the emission spectrum peaked at 490 nm. Under vacuum at 77°K, or at 286°K under all conditions, the spectrum peak shifted to 520 nm. Similar shifts were observed for the other compounds. A conceptual model, the exciton hypothesis, was advanced to interpret the temperature and gas pressure effects on radioluminescence. (auth)

40857 UNIFORM SURFACE PREPARATIONS FOR EVAPORATING RADIOACTIVE SOLUTIONS. K. H. Koenig (Johann-Wolfgang-Goethe-Universität, Frankfurt am Main). Atompraxis, 9: 364-5(Sept. 1963). (In German)

Radionuclides in vehicle solutions are uniformly deposited on surfaces with defined geometry if the object vehicles are rotated on both axes during evaporation, so that the drops with the precipitated solid particles are moved radially over the object vehicles. Description is given of a device constructed for this purpose, together with a simple procedure for making hydrophobic boundaries for the radiating surface on flat object vehicles. (auth)

40858 PREPARATION OF CALIBRATED RADIATION SOURCES FOR ALPHA-RAY SPECTROMETRY. K. H. Koenig (Johann-Wolfgang-Goethe-Universität, Frankfurt am Main). Atompraxis, 9: 365-7(Sept. 1963). (In German)

Preparations with vehicle-free precipitates of Po^{210}, Bi^{212} (ThC), Po^{212} (ThC′), and Po^{214} (RaC′) are used for calibrating alpha-ray spectrometers. The manufacture of such combined preparations by means of successive deposition of the nuclides on the object vehicle according to various procedures is described. (auth)

40859 CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS. [PART] II. L. Lindner. Atoomenergie Haar Toepassingen, 5: 162-8(Aug. 1963). (In Dutch)

Experimental results of the effects of radiation on inorganic systems were reported for two cases: recoil atoms originating from the central atom of oxygen-containing anions, and recoil atoms originating from complex ions. Theoretical aspects of the transformations were considered. (J.S.R.)

40860 THE RADIATION-INDUCED ADDITION OF ACETALDEHYDE TO ISOBUTYLENE. Shinji Iizuka, Motoyoshi Hatada, and Kozo Hirota (Japanese Assn. for Radiation Research on Polymers, Osaka and Osaka Univ.). Bull. Chem. Soc. Japan, 36: 817-23(July 1963). (In English)

The radioinduced addition of acetaldehyde to isobutylene was found to proceed at room temperature; the G(telomer)'s are smaller by one or two orders of magnitude than those when ethylene or propylene is adopted as the taxogen, and they increase markedly with the temperature, reaching a maximum at 110 ~ 150°C. It is shown from the gas chromatographic and NMR analyses of the telomer produced that the radical chain mechanism proposed previously is reasonable, although minor products seem to be formed in accordance to an ionic mechanism. It was found that the G values of all the telomers decrease in the presence of several solid materials, suggesting the catalytic decomposition of acetyl and other intermediate radicals. (P.C.H.)

40861 POLYMERIZATION OF UNSATURATED COMPOUNDS INITIATED BY GAMMA RADIATION. M. Lazar, R. Rado, and N. Kliman. Chem. Zvesti, 11: 230-5(1957). (In Slovak)

Regularities to which gamma-induced polymerization reactions conform are reported. The character and mechanism of the initiation were determined, and the possibility of a practical application was evaluated. (tr-auth)

40862 THE USE OF AN AQUEOUS FORMIC ACID SOLUTION AS A CHEMICAL DOSIMETER. I. Janovský, B. Bartoníček, and J. Bednář (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Řež). Collection Czech. Chem. Commun., 28: 2245-6(Aug. 1963). (In German)

The yields of reducing substances in the irradiation of sodium formate solutions are dependent on the formate concentration. For Co^{60} γ radiation, lower yields were observed than with 3-Mev electrons. It is therefore doubtful whether this system will find extensive application as a chemical dosimeter. (tr-auth)

40863 THE PREPARATION OF A COPOLYMER GRAFT OF POLYTETRAFLUORETHYLENE (TEFLON) WITH METHYLMETHACRYLATE. V. V. Korshak, K. K. Mozgova, and T. M. Babchinitser (Inst. of Metal-Organic Compounds, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 151: 1332-4(Aug. 21, 1963). (In Russian)

The adhesion of teflon can be improved by forming a copolymer on the surface by irradiation. An electric discharge in air or oxygen is a simpler and milder method than irradiation for formation of a copolymer graft on a teflon surface. An electric discharge is initiated between two glass insulating tubes in a gap 1.5 to 2.0 mm in diameter by a 50 cycle per second current at 22 to 30 kilovolts. The teflon film is placed in the discharge zone for 10 to 30 minutes, and methylmethacrylate is grafted onto the activated teflon surface by polymerizing in the presence of the methylmethacrylate monomer at 85 to 90°C to a conversion of 4 to 5%. The graft film is removed by boiling for 10 hours with dichloroethane and acetone, dried to constant weight, and analyzed for a change in properties as compared to the starting material. Chemical analysis for C, F, and H were carried out on the initial teflon, and on graft copolymers containing 3.26 and 8.42% methylmethacrylate. An infrared absorption spectrum of the graft film showed an absorption band at 1700 cm^{-1} characteristic of the CO-group, and other bands at 1450 and 300 cm^{-1} characteristic of the CH_3-group. Although the initial teflon film could not be glued to steel with one of the thermostable glues, it was found that the grafted teflon sheet could be bonded to steel with a strength varying from 5 to 22 to 25 kg/cm^2 (depending on the amount of grafted methylmethacrylate). (TTT)

40864 MÖSSBAUER SPECTRA OF IRON COMPLEXES CONTAINING DIECETYLTHIOSEMICABAZONEOXIME ($DTOH_2$) AND THE METHYL ETHER DERIVATIVE ($DTOHM_e$). A. V. Ablov, G. N. Belozerskii, V. I. Gol'danskii, E. F. Makarov, V. A. Trukhtanov, and V. V. Khrapov (Inst. of Chemical Physics, Academy of Sciences, USSR and Inst. of Chemistry, Academy of Sciences, Moldavian SSR). Dokl. Akad. Nauk SSSR, 151: 1352-5(Aug. 21, 1963). (In Russian)

Mössbauer absorption spectra were investigated on compound I which is an addition product of $DTOH_2$ and $FeCl_2$ (II), on compound II which can be represented by a formula Fe(DTOH) (removal of two hydrogen atoms), and on compound III or $Fe(DTOMe)_2$ which is a methyl ether derivative. Co^{57} plated on chromium and fixed by thermodiffusion at 800°C in a hydrogen atmosphere was used as a source of 14.4-kev gamma quanta. A scintillation counter with a NaI(Tl) crystal 1 mm thick was used as a detector. The resonance absorption spectrum was analyzed on a 100-channel amplitude analyzer. The Co^{57} source was maintained at room temperature, while the absorber was held at room temperature (300°K) and at the temperature of liquid nitrogen (78°K). No Zeeman splitting of the ground

state or excited state of Fe^{57} was observed. Direct measurements showed that the compounds were diamagnetic. The chemical shift S in mm/sec and quadrupole splitting Δ in mm sec were determined for these compounds. The values of S were 0.47 at 78°K (Δ = 0.65) and 0.42 at 300°K (Δ = 0.66) for compound I, 0.29 at 78°K and 0.22 (Δ = 2.02) at 300°K for compound II, and 0.50 (Δ = 0.88) at 78°K and 0.45 (Δ = 0.88) for compound III. The quadrupole splitting increased sharply in compound II, while the chemical shift decreased. Compounds I and II gave a similar Mössbauer spectrum. A calculation of the molecular orbitals is required for a complete quantitative explanation of these effects. (TTT)

40865 APPROXIMATE VALUES OF REACTION RATE CONSTANTS OF RADIATION REACTIONS INVOLVING A HYDRATED ELECTRON. A. K. Pikaev, P. Ya. Glazunov, and Vikt. I. Spitsyn (Inst. of Physical Chemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 151: 1387-9 (Aug. 21, 1963). (In Russian)

In the radiolysis of water, it was assumed that the hydrated electron e^-_{aq} is converted to an H atom by reaction with a hydrogen ion. Hence, the reactivity of e^-_{aq} can be estimated from a study of the effect of pH on the radiation yield of ferrous iron in sulfuric acid. A plot of $G(Fe^{3+})$ is given as a function of dose rate for a 3×10^{-3} M solution of Mohr's salt saturated with oxygen in 0.4 M H_2SO_4 and at a pH of 3.0. A plot of $G(Fe^{3+})$ as a function of pH is given at a dose rate of 1.3 to 1.5×10^{23} ev/ml-sec. The value of $G(Fe^{3+})$ decreases with increasing pH for a constant Fe^{2+} concentration. The radiolytic conversions in this system can be explained by the following reactions: 1) $H_2O \rightsquigarrow H, OH, e^-_{aq}, H_2, H_2O_2$; 2) $e^-_{aq} + H_3O^+ \rightarrow H + H_2O$; 3) $H + O_2 \rightarrow HO_2$; 4) $H + OH \rightarrow H_2O$; 5) $Fe^{2+} + OH \rightarrow Fe^{3+} + OH^-$; 6) $H^+ + Fe^{2+} + HO_2 \rightarrow Fe^{3+} + H_2O$; 7) $Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + OH + OH^-$. In 0.4 M H_2SO_4, the hydrated electrons are completed converted to H atoms. At a pH > 2, reaction (2) competes with the following reactions: 8) $e^-_{aq} + O_2 \rightarrow O_2^-$; 9) $e^-_{aq} + OH \rightarrow OH^-$; and 10) $O_2^- + H^+ \rightleftharpoons HO_2$. In 0.4 M H_2SO_4, the value of K_3K_5/K_4 was estimated to be $3.2 \pm 1.2 \times 10^7$ l/mol-sec. It can be assumed that the reaction rate constant $K_3 \cong K_8$ and $K_4 \cong K_9$. It is found that $K_8 \cong 5 \times 10^9$ l/mol-sec, and $K_9 \cong 4 \times 10^{10}$ l/mol-sec. The reaction rate of the hydrated electron e^-_{aq} is estimated to be 5×10^9 with H+, 2.7×10^9 with H_2O_2, 1.5×10^9 with $ClCH_2COOH$, 2.2×10^9 with acetone, 4.9×10^9 with NO_3^-, 4.0×10^9 with $[Fe(CN)_6]^{3-}$, 2.2×10^5 with NH_4^+, 3.8×10^6 with $H_2PO_4^-$, 6.3×10^7 with HF (HF_2^-), 6.3×10^9 with N_2O, and 1.5×10^{10} l/mol-sec with CO_2. These absolute reaction rate constants for the hydrated electron were estimated from data in the literature. (TTT)

40866 KINETICS OF GAS EVOLUTION IN THE LOW-TEMPERATURE RADIOLYSIS OF PARAFFIN AND POLYETHYLENE. G. K. Vasil'ev, V. E. Skurat, and V. L. Tal'roze (Inst. of Chemical Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 152: 356-8(Sept. 11, 1963). (In Russian)

Samples of paraffin and high-density polyethylene in the form of disks 0.1 to 0.8 mm thick and weighing 0.03 to 0.2 g were irradiated with 1.6-Mev electrons at liquid-nitrogen temperatures. The glass ampule was evacuated to 10^{-2} mm Hg std, and the gas pressure was measured during irradiation with a U-shaped oil manometer. Pressure readings were taken by remote control on a television camera. The hydrogen concentration was measured by a mass spectrometer. The absorbed dose was calculated from the electron beam passing through the sample. The amount of gas evolved was plotted as a function of the irradiation dose at −175°C. The rate of hydrogen evolution increased with increasing dose in paraffin, but did not increase in polyethylene up to a dose of 2000 M rad. The apparent radiation yield for the evolution of hydrogen from polyethylene was 0.21 at a dose of 4500 to 6200 M rad. On heating the samples, additional hydrogen was evolved, and the kinetics of hydrogen evolution can be described by the following equation: $\ln[1 - (Q(t)/Q_0)] = -(\pi^2 Dt/4l^2)$. Here Q(t) is the amount of hydrogen evolved at time t: Q_0 is the total amount of trapped hydrogen; D is the diffusion coefficient for hydrogen, and l is the half-thickness of the sample. A plot of $-\ln\alpha = -\ln(\pi D^2/4l^2)$ versus $10^3/T$ (reciprocal of the temperature) gave a straight line for the paraffin sample with an activation energy $E = 3.4 \pm 0.5$ kcal/mol for the diffusion coefficient D. Polyethylene did not give a straight-line plot. The volume ratio of trapped hydrogen in cm^3 under normal conditions to sample weight was 10 for paraffin at a dose >250 M rad, 100 for polyethylene at a dose of 2000 M rad, 260 for polyethylene at a dose of 4550, and 285 for polyethylene at a dose of 6250 M rad. (TTT)

40867 SOLID PHASE RADIATION POLYMERIZATION. A. Chapiro. Intern. Chem. Eng., 3: 557-62(Oct. 1963).

General characteristics of solid-phase radioinduced polymerization are described. A classification was made of the various systems of monomers on the basis of their kinetic behavior after irradiation. The radioinduced polymerization of styrene, acrylonitrile, 3,3-bis(chloromethyl) oxetane, methylmethacrylate, methylacrylate, vinyl carbazole, and vinyl pirrolidone are described. (M.C.G.)

40868 CHROMATOGRAPHIC LOSS OF CARRIER-FREE I^{131}. L. J. Anghileri (Volk Radiochemical Co., Chicago). Intern. J. Appl. Radiation Isotopes, 14: 427-8 (Sept. 1963). (In English)

Quantitative chromatography of radioiodine determinations was carried out. The results showed a great release of I by oxidation in the presence of air, the paper seemingly acting as a catalytic agent. A very low increase in the amount of carrier sodium iodide (2-10 μg) seemed to increase oxidation in the presence of air. The presence of carrier iodide in solvents containing HCl improved the stability or retention of I^{131}. Drying chromatograms with iodide (I^{131}), carrier-free or with amounts of carrier below 50 μg, can be expected to lose as high as 40% in the first 24 hr and the loss increases with time to values as high as 70% in 4 days. With neutral or basic solvents the results are better. The use of organic solvents, as in the case of butanol-acetone-water, indicated that a part of the iodide is oxidized and incorporated in the solvent as an iodine compound. (P.C.H.)

40869 THE REACTIONS OF METHYL RADICALS IN THE SOLID-, AND GAS-PHASE PHOTOLYSIS OF DIMETHYLMERCURY. R. E. Rebbert and P. Ausloos (National Bureau of Standards, Washington, D. C.). J. Am. Chem. Soc., 85: 3086-9(Oct. 20, 1963).

The gas-phase photolysis of CD_3COCD_3 was investigated in the presence of CH_3HgCH_3 from 376 to 453°K. From the isotopic distributions of the methane and ethane fractions, evidence was obtained for the occurrence of the reaction: $CD_3 + CH_3HgCH_3 \rightarrow CD_3HgCH_3 + CH_3$ (E_{act} = 12.6 kcal/mole). The reaction is also postulated to occur in the liquid-phase photolysis of dimethylmercury. From the isotopic distribution of the ethane produced in the liquid- and solid-phase photolysis of $CH_3HgCH_3-CD_3HgCD_3$ mixtures, it was concluded that cage recombination of methyl radicals does take place. Contrary to previous conclusions, no evidence could be obtained for hot methyl radical effects in the liquid-phase photolysis of dimethylmercury. (auth)

40870 DETECTION OF ^{146}Pm AMONG THE PRODUCTS OF URANIUM FISSION. F. P. Roberts, E. J. Wheelwright, and H. H. van Tuyl (General Electric Co., Richland, Wash.). J. Inorg. Nucl. Chem., 25: 1298-1300(Oct. 1963). (HW-SA-2894)

Rare earths were separated from a sample of aged mixed fission products and the sample was then reactor irradiated. The activity at reactor discharge was 1.23×10^{-8} total gamma from Pm^{146} per beta from Pm^{147}. Using a value of 1.30 gamma per Pm^{146} decay, the ratio at reactor discharge of Pm^{146} atoms to Pm^{147} atoms was found to be 6.9×10^{-7}. Reactor conditions for different Pm^{146} yields are discussed. (P.C.H.)

40871 MOLECULAR EXCITATION OF WATER BY γ-IRRADIATION. D. N. Sitharamarao and J. F. Duncan (Univ. of Melbourne). J. Phys. Chem., 67: 2126-32(Oct. 1963).

A cadmium sulfide crystal counter was used to investigate the thermoluminescence of γ irradiated ice and the fluorescence from ice and water during Co^{60} γ-irradiation. The results afford evidence for the formation of OH radicals in the $(^2\Sigma)$ state in both ice and water, some of which lose their energy by radiation emission to form the ground $(^2\Pi)$ state. In ice, there appears to be a large number of electron traps of varying depths, approximately 2.4 ev above the ground state. (auth)

40872 THE FORMATION AND DECAY OF H_2O_3 AND HO_2 IN ELECTRON-IRRADIATION AQUEOUS SOLUTIONS. Gideon Czapski and Benon H. J. Bielski (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 67: 2180-4 (Oct. 1963). (BNL-6840)

The kinetics of the reaction between perhydroxyl radicals, HO_2, were studied at 23°C. The radicals were generated in rapidly flowing water containing dissolved oxygen by an electron beam from a Van de Graaff accelerator, and the quantity remaining at any time after irradiation was determined by rapid mixing with a solution containing tetranitromethane, which reacts with HO_2 radicals. The rate constants found were $k_{HO_2+HO_2} = 2.2 \times 10^6\ \underline{M}^{-1}\ sec^{-1}$ and $k_{O_2^-+O_2^-} = 1.5 \times 10^7\ \underline{M}^{-1}\ sec^{-1}$, and the pK of HO_2 was found to be 4.4 ± 0.4. Another intermediate, believed to be H_2O_3 on kinetic grounds, was found to exhibit pseudo-first-order disappearance, the first-order rate constant being a function of acidity. The intermediate was found using ferrous sulfate as the scavenger solution. The half life of H_2O_3 reaches a maximum of 2 sec in 0.02 $\underline{M}$ (H^+), decreasing to less than 0.1 sec in 1 and 10^{-4} $\underline{M}$ (H^+). The kinetics are shown to agree well with acid- and base-catalyzed decomposition of H_2O_3 to form $H_2O + O_2$. (auth)

40873 ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED SINGLE CRYSTALS OF SUGARS. Hisashi Ueda (Duke Univ., Durham, N. C.). J. Phys. Chem., 67: 2185-90(Oct. 1963).

Single crystals of lactose hydrate, sucrose, methyl-D-glucoside, glucoronolactone, D-glucosamine-HCl, and diacetone sorbose were irradiated at 77°K and their esr spectra were observed immediately after irradiation or after annealing at 193°K. The sugars also were irradiated at room temperature, and their esr spectra observed. The position of the substituted functional group in a substituted sugar molecule is more accessible to radiation damage than other positions in the molecule. Therefore, the positions are selectively damaged by irradiation. For this reason, the esr spectra of irradiated single crystals of sugar derivatives differ greatly from those found in the unsubstituted parent sugars. The free radicals formed in sugars by irradiation at 77°K are transformed by subsequent annealing. The transformation processes can be explained by a change in the configuration of the radical species in most instances. However, there are a few cases where the transformation includes migration of the free-radical site. (auth)

40874 RADIATION DECOMPOSITION OF SODIUM CHLORATE; COMPARISON OF YIELDS AND THE POST-IRRADIATION ANNEALING BEHAVIOR FOR IRRADIATION BY γ-RAYS AND α-PARTICLES. C. J. Hochanadel (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 67: 2229-30 (Oct. 1963).

The production of chloride as a function of gamma and alpha radiation doses was compared. The yield for decomposition by alpha particles at 25°C was found to be about the same as the yield for samples irradiated with gamma rays at 25°C and then annealed at ~200°C, or for samples irradiated with gamma rays at ~185°C. The results are consistent with a previous postulate that thermal effects in alpha particle tracks are a significant factor in the radiolysis. (P.C.H.)

40875 ISOTOPE EFFECTS IN THE MERCURY-PHOTOSENSITIZED DECOMPOSITION AND THE DIRECT RADIOLYSIS OF THE SYSTEMS METHANE, METHANE-d_4 AND BUTANE, BUTANE-d_{10}. E. G. Spittler, S. J. P. Jordan, Leon M. Dorfman, and Myran C. Sauer, Jr. (Argonne National Lab., Ill.). J. Phys. Chem., 67: 2235-7(Oct. 1963).

Studies were made on the isotopic distribution of hydrogen formed in the four abstraction reactions involving H and D atoms and the two isotopic hydrocarbon molecules for comparison with radiation chemical data. The most stricking result was the observation of very large isotope effects in the mercury-photosensitized decompositions. The hydrogen distributions obtained in both samples were qualitatively similar and suggest that large isotope effects in quenching and abstraction exist in both cases. In the radiolysis of equimolar C_4H_{10}-C_4D_{10} and CH_4-CD_4 mixtures, the hydrogen distributions were quite different from those obtained in the mercury-photosensitized decomposition of similar mixtures. (P.C.H.)

40876 ON Co^{60} GAMMA RAY-INITIATED EMULSION POLYMERIZATION. G. J. K. Acres and F. L. Dalton (Wantage Radiation Lab., Berks, Eng.). J. Polymer Sci., Pt. A, 1: 3009-20(Oct. 1963).

A study was made of the Co^{60} γ-ray-initiated polymerization of methyl methacrylate and styrene; conversion rates were measured by a dilatometric method. The dependence of polymerization rate on monomer concentration and radiation intensity was determined for each monomer. It is shown that the emulsion polymerization of methyl methacrylate can be described by accepted theories of emulsion polymerization; in the case of styrene a dependence of intensity exponent on monomer concentration was found. Such a dependence does not occur when conventional initiating systems are used, and cannot be explained without some modification of theory. (auth)

40877 ESR STUDY OF IRRADIATED ACRYLIC ACID AND REACTION OF THE PRODUCED RADICAL. Yuji Shioji, Shun-ichi Ohnishi, and Isamu Nitta (Japanese Assn. for Radiation Research on Polymers, Osaka). J. Polymer Sci., Pt. A, 1: 3373-84(Nov. 1963).

A single crystal of acrylic acid $CH_2=CH-COOH$ was irradiated at −196°C and its ESR spectrum was measured at the same temperature with various crystal orientations with respect to the external magnetic field. At −196°C the spectrum appears as a double quartet, the doublet showing anisotropy. By analyzing the spectrum, the hyperfine cou-

pling tensor was derived. The result showed that the radical was $CH_3-CH-COOH$ produced by hydrogen addition to the double bond. Referring to the molecular orientation of acrylic acid in the crystal, it was found that the radical was oriented in the crystalline lattice in the same way as the undamaged molecule. When the temperature was raised from −196°C the double quartet spectrum began to decay at −100°C, and there remained a triplet spectrum showing no anisotropy. The triplet may be attributed to a propagating type radical $\sim CH_2-\dot{C}H(COOH)$. In order to compare the ESR result with polymerization process, monomer preirradiated at −196°C was postpolymerized at various elevated temperatures. It was found that although the radical decayed at −78°C no discernible polymer was obtained at that temperature. The results suggest that, although the radical can move and be reactive at −78°C, which is far below the melting point, it does not seem sufficiently mobile to permit growth of the propagating chain to any observable extent. (auth)

40878 RADIATION VULCANIZATION OF SILICONE RUBBERS. Jaroslav Bína and Tibor Ertl (Cable Insulator Research Inst., Bratislava). Jaderna Energie, 9: 125-7 (1963). (In Czech)

The high-molecular silicoörganic compounds represent a new class of materials with excellent heat-resisting properties and high elasticity. The vulcanization process, resulting in linking, may be induced by various agents, such as organic peroxides, sulfur-containing compounds, and organo-metallics; in addition, excellent results were obtained by using the γ radiation of Co^{60} sources for inducing the process. In the insulated electrical cable industry, use of radiation vulcanization resulted in a considerable improvement of the final product while simplifying the fabrication process. The total dose required depends greatly on the molecular weight of the end product; for a molecular weight of about 50,000, about 25 Mr are required. The strength of the material could be increased by a factor of 10 to 20. Dimethyl siloxanes were used most often for electrotechnical applications. Reactor fluxes of the order of 10^{14} n/cm^2 sec were used for vulcanization processes. (61 references). (TTT)

40879 EFFECT OF THE CHEMICAL NATURE OF FILLER SURFACE AND IONIZING RADIATION ON THE PROPERTIES OF RUBBERS. A. A. Chuyko, I. E. Neymark, I. M. Landau, E. V. Tsepenyuk, and E. A. Chuyko. Kauchuk i Rezina, No. 6, 31-4(1963).

The effect of the chemical nature of the filler surface on the physicomechanical properties of rubbers was studied. Butadiene-styrene (SKS-30), nitrile (SKN-40), and sodium butadiene (SKB) rubbers loaded with unmodified silica and with silica whose surface hydroxyls had been substituted by allyloxy or vinyl radicals were used. Use of modified silica in standard rubber mixes (containing 100 parts rubber and 50 to 60 parts filler) was shown to improve the physicomechanical properties of the vulcanizates. For example, the tensile strength of SKN-40 rubber containing 60% filler increased from 126.3 kg/cm^2 with unmodified silica to 163.6–168 kg/cm^2 with vinyl-substituted silica (vinyl silica). This improvement was attributed to greater compatibility of the filler and the rubber and to a reaction between the olefin radicals of the filler surface and the rubber with the possible formation of C–C and C–S–C linkages. The effects of ionizing radiation from a Co^{60} source at a dose rate of 77 r/sec on nonloaded SKS-30 rubber and on SKS-30 loaded (ratio 1/1) with unmodified and with modified silica (Belaks) containing 2.5% vinyl, methyl, or ethyl radicals was also studied. Irradiation did not affect the tensile strength and the modulus at 100% elongation of unloaded rubber but considerably improved these properties in loaded rubbers, particularly with vinyl silica. The maximum effect of irradiation was attained after 48 hr. These results were attributed to the participation of the filler in the formation of the three-dimensional network. It was concluded that the structure and the physicomechanical properties of vulcanizates can be controlled by modifying the nature of the organic radicals on the silica surface, the number of such radicals, the composition of the vulcanizates, and the method of vulcanization. (TCO)

40880 A NEW RADIOCOLLOID LABELED WITH P^{32}. STUDY ON THE FORMATION MECHANISM AND ITS BIOLOGICAL BEHAVIOR. B. Bellion, G. Buechi, S. Chiarle, S. Orsello, U. Rosa, and S. Sosi (Università, Turin; Societa Ricerche Impianti Nucleari, Saluggia, Italy; and Centro di Ricerche Nucleari, Saluggia, Italy). Minerva Nucl., 7: 237-42(June 1963). (In Italian)

In a series of investigations on radiocolloids for therapeutic uses, a method was devised for the preparation of a P^{32}-labeled colloid which differs sharply from all those proposed previously. This compound is a chrome oxide which is formed by two stages: first, a colloid base is formed; and, second, the base is labeled with P^{32}. A colloid formed by particles 200 to 600 Å in diameter and another consisting of particles whose diameter ranges from 1,000 to 10,000 Å were thus obtained. Both types of radiocolloid were submitted to painstaking chemico-physical and biological examinations which confirmed their stability. The size of the particles is of importance in determining the different biological behavior of the radiocolloid. (auth)

40881 ELECTRON SPIN RESONANCE EVIDENCE OF RADIATION-INDUCED ELECTRONS TRAPPED IN ORGANIC GLASSES AT 77°K. C. Chachaty and E. Hayon (Centre d'Etudes Nucleaires, Saclay, France). Nature, 200: 59-60(Oct. 5, 1963).

Electron-spin-resonance evidence of radioinduced electrons trapped or solvated in glasses at 77°K in the radiolysis of alcohols is presented. (M.C.G.)

40882 RADIATION-INDUCED HYDROLYSIS OF ACETAL: EVIDENCE FOR THE REACTION OF H_3O^+ IONS IN SPURS IN THE RADIOLYSIS OF WATER. D. R. Smith and W. H. Stevens (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nature, 200: 66-7(Oct. 5, 1963).

It was previously demonstrated that in water close to pH 7 and at pH 4, the reducing radical formed during radiolysis bears a unit negative charge. This suggests that an ejected electron escapes from its parent H_2O^+ ion and that H_2O^+ ions temporarily exist in a spur. Experimental results that are interpreted as evidence for this effect are presented. Aerated aqueous solutions of diethyl acetal were irradiated with 50-kv x rays. Acetaldehyde and ethanol were formed. Results are interpreted as hydrolysis catalyzed by H_3O^+ (hydrolysis product of H_2O^+) formed in spurs, in competition with both neutralization of H_3O^+ and dilution of H_3O^+ by spur expansion. (M.C.G.)

40883 THE SEPARATION OF ^{242}Cm FROM JRR-1 NEUTRON IRRADIATED ^{241}Am. CATION EXCHANGE WITH α-HYDROXY ISOBUTYRATE. Takeo Fujino (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 640-3(Aug. 1963). (In English)

The separation was carried out at room temperature by elution with 0.5M ammonium α-hydroxy isobutyrate of pH 3.68 from the column of 8% cross linked Diaion SK # 1. The flow rate of 1 drop/5 min was found to give a good separation of Cm^{242} from Am^{241}. The separation factor was

calculated to be 1.49. Radiochemical purity of curium fraction was checked by means of decay curve and α pulse height analyses. (auth)

40884 PRODUCTION OF ^{35}S BY THE NEUTRON IRRADIATION ON POTASSIUM CHLORIDE. SEPARATION OF ^{35}S BY THE COMBINED METHOD OF PRECIPITATION AND ANION EXCHANGE. Eiji Shikata (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 644-51(Aug. 1963). (In English)

Ten grams of the neutron irradiated potassium chloride were dissolved in 20 ml of boiling water, which contained 10 mg of phosphate. Sixty milliliters of ethanol were added to the solution. After being cooled to room temperature potassium chloride precipitate was filtered off. The filtrate was diluted by the addition of 300 ml of water and passed through an anion exchange resin column in chloride form. The column was washed with water. P^{32} was eluted with 0.05N hydrochloric acid and then S^{35} with 2N hydrochloric acid. Various conditions of the separation and quality of S^{35} prepared by this method were investigated. By pre-treatment with ethanol prior to the anion exchange separation, the K_d value of $S^{35}(S^{35}O_4^{2-})$ against the anion exchange resin was increased without increasing the volume of the solution and the separation was made easily. The specific activity of S^{35} prepared by this method was about ten times as high as that prepared by the cation exchange method. The percentage of S^{35} recovered was about 80%. The separation factor against P^{32} formed simultaneously by the neutron irradiation was 1.3×10^4 at maximum. (auth)

40885 RADIOLYTIC INACTIVATION OF CHYMOTRYPSINOGEN BY ^{60}Co γ-RAYS. Kazuko Muroshima (Tokyo Univ.), Hiroshi Hashizume, Niro Matsuura, Kazutomo Imahori, and Masao Takizawa. Nippon Kagaku Zasshi, 84: 514-19(1963). (In Japanese)

The radioinduced biochemical inactivation and polarographic wave decrease of chymotrypsinogen were investigated in aqueous phase and the obtained radiochemical yields were discussed from a stoichiometric point of view based on radical theory of radiolysis. The yields of enzyme inactivation were independent over a wide range of chymotrypsinogen concentration, providing G-value 0.51. On the contrary, polarographic yields corresponding to numbers of functional cystine destroyed for each 100 ev of energy absorption, depended on the concentration of protein. The reciprocal plots of radiochemical yields in G-value against the reciprocal solute concentration yielded a straight line intersecting the coordinate axis of (1/G) at 0.5, that means the hypothecal G-value 2.00 for a perfect radical scavenging. At a γ dose lower than 20 Krep, radicals generated by radiolysis of water are consumed entirely for enzyme inactivation, while polarographic cystine wave is left unchanged or even somewhat increases. Once enzyme activity is lost, marked decrease in cystine wave appears. Along with these observations differential absorption spectra of irradiated protein solution were measured at wave length about 280 and 290 mμ, showing that the destruction of tertiary structure and tryptophane residue of the protein could be detected at γ-ray dose lower than 20 Krep. From the stoichiometric evidences the tertiary structure and tryptophane residue of the protein molecule seemed to be attacked prior to the functional cystine group and the degradation with no redox reaction could be ascribed to the direct transfer of radical recombination energy. (auth)

40886 THE RADIOLYSIS OF CYCLOHEXANE. IV. THE EFFECT OF SOLUTES ON THE RADIOLYSIS OF LIQUID CYCLOHEXANE. Kiyoaki Kikuchi, Shin Sato, and Shoji Shida. Nippon Kagaku Zasshi, 84: 561-3(July 1963). (In Japanese)

The effect of the addition of various solutes, such as iodine, aromatic and olefinic compounds, and acetylene, on the γ radiolysis of liquid cyclohexane was investigated by measuring the yield of hydrogen and in some cases those of hydrogenated compounds of the solutes. Addition of solutes decreases $G(H_2)$ from cyclohexane in the orders; benzene > cyclohexene > naphthalene > diphenyl > anthracene > iodine; and ethylene > propylene > acetylene > isobutene. The orders correspond to those of the ability in the radical scavenging. When unsaturated lower hydrocarbons were used as solutes, the hydrogenated compounds of the solutes were detected by gas chromatography, which are considered to be produced by scavenging H atoms. (auth)

40887 RADIATION CATALYSIS OF ETHYL BROMIDE — SIX MONTHS "ON-STREAM". David E. Harmer and John S. Beale Jr. (Dow Chemical Co., Midland, Mich.). Nucleonics, 21: No. 9, 76-7(Sept. 1963).

Commercial production of ethyl bromide using gamma-radiation as a catalyst is discussed. A two-phase gas-liquid reaction was chosen over a gaseous reaction and over a single-phase liquid reaction. Ethyl bromide is manufactured from ethylene and hydrogen bromide. (R.E.U.)

40888 RADIATION CHEMISTRY AND INSTRUMENTATION IN JAPAN. E. J. Henley (Stevens Inst. of Tech., Hoboken, N. J.). Nucleonics, 21: No. 9, 78; 80-1(Sept. 1963).

The status of Japanese commercial radiation applications, their efforts in radiation chemistry, and their progress in development of instrumentation are summarized. (R.E.U.)

40889 THE RADIATION CHEMISTRY OF AQUEOUS FERROUS SULFATE–BENZOIC ACID SOLUTIONS. Janet Geisselsoder, Mary Jane Kingkade, and John S. Laughlin (Sloan-Kettering Inst., New York). Radiation Res., 20: 263-9(Oct. 1963).

The effects of Cl^- and O_2 observed when other organic compounds were introduced into the Fricke dosimeter were also observed with a ferrous sulfate-benzoic acid system, although ferric yield was considerably more reproducible in this case than in previously tried systems. The conclusion that peroxides are formed was reinforced by the fact that ferrous ion is oxidized by benzoic acid solutions which have previously been irradiated. The production of hydroxy isomers of benzoic acid was found to occur to a greater extent in this system (G_o = 1.9 molecules per 100 ev; G_m = 3.1; G_p = 1.6) than in alkaline solution of benzoic acid alone as investigated by Armstrong et al. (G_o = 0.67 molecule/ev; G_m = 0.37; G_p = 0.37), and in different ratios from those found by Armstrong (o/m/p = 9 : 5 : 5) or by Loebl et al., who irradiated at pH 3 and got ratios of 5 : 2 : 10. These discrepancies might indicate either differences in analytic technique or a fundamental difference in mechanism due to the presence of ferrous ion. (auth)

40890 ELECTRON SPIN RESONANCE STUDIES ON γ-IRRADIATED LiF. W. Marth (Isotopen-Studiengesellschaft e.V., Institut Karlsruhe, Ger.). Radiochim. Acta, 1: 217-18(Aug. 1963). (In German)

Investigations were made of the structure of defects in irradiated LiF by studies of electron spin resonance spectra. The F centers were considered. The LiF single crystal was irradiated using a 10-c Co^{60} source at room

temperature. Spectroscopic measurements of the optical absorption band pointed to a F-center concentration of about 5×10^{17} spins/cm^3. (M.C.G.)

40891 CATION ISOTOPE EFFECT IN SZILARD-CHALMERS PROCESS. T. Andersen and A. G. Maddock (Cambridge Univ., Eng.). Radiochim. Acta, 1: 220-1(Aug. 1963). (In English)

An investigation of the influence of the mass of the cation was made using electromagnetically enriched isotopes of Mg and Zn, in an attempt to discover some of the factors determining the retention, after neutron irradiation of solid substances. The results indicated a small but measurable effect of the mass of the cation. The compound containing the heavier isotope always showed the lower retention. The retention of normal $MgCrO_4$ (79% Mg^{24}, 10% Mg^{25}, 11% Mg^{26}) was 55.8% ± 0.4% in agreement with the retention calculated from the results for the enriched $MgCrO_4$ samples and the known isotopic composition of the element. (P.C.H.)

40892 PROTACTINIUM-236. Gerda Wolzak and H. Morinaga (Instituut voor Kernphysisch Onderzoek, Amsterdam). Radiochim. Acta, 1: 225-6(Aug. 1963). (In English)

Protactinium-236 was prepared by mixing 0.8 mg uranyl nitrate with about 40 mg fine graphite powder and bombarding for 5 min by a 26 Mev internal deuteron beam. On the basis of the cross section, which was calculated to be roughly of the order of 100 μb from the reaction $U^{238}(d,\alpha)Pa^{236}$, the half life of Pa^{236} was assigned as 12 min. The Curie plot and decay curve of Pa^{236} is illustrated. (P.C.H.)

40893 RADIATION-INDUCED POLYMERIZATION OF VINYL FLUORIDE. Kh. U. Usmanov, A. A. Yul'chibaev, R. Mukhamedzhanov, A. A. Gordienko, A. Valiev, A. A. Patenko, and G. S. Dordzhin. Vysokomolekul. Soedin., 5: 1277(1963).

Polyvinyl fluoride was irradiated in sealed ampoules with γ rays from a Co^{60} source at a dose rate of 34 r/sec. Irradiation in the absence of initiators yielded waxy products. In the presence of benzoyl peroxide a yellowish solid product was obtained. The PVF yield increased in both cases with an increase in the radiation dose. Acceleration of the polymerization in the initiator indicates that the polymerization follows the radical mechanism. (TCO)

40894 GAMMA IRRADIATION OF $Fe(CO)_5$ AND RADIOCHEMICAL SYNTHESIS OF PHILODIENE IRON TETRACARBONYL. E. Koerner von Gustorf, M.-J. Jun, and G. O. Schenck (Max-Planck-Institut für Kohlenforschung, Mülheim an der Ruhr, Ger.). Z. Naturforsch., 18b: 767-8(Sept. 1963). (In German)

Gamma irradiation of $Fe(CO)_5$ at 20 to 25°C in benzol or cyclohexane produced $Fe_2(CO)_9$ and $[Fe(CO)_4]_3$. (M.C.G.)

40895 DATA ON THE RECOMBINATION OF RADICALS FROM VARIOUS TRACKS IN RADIOLYSIS AND HOMOGENEOUS CATALYSIS. III. THE RANGES OF CONCENTRATION AND IRRADIATION RATES WITHIN WHICH THE SIMPLE RADIOLYSIS MODEL IS VALID. V. M. Byakov and B. V. Ershler. Zh. Fiz. Khim., 37: 2016-21(Sept. 1963). (In Russian)

The I correlations manifested in the radiolysis of certain solutions point to recombination of active particles (radicals) arising in various tracks. A consideration of the interaction of the radicals shows that their concentration is practically constant over the entire bulk of the solution over a large range of both acceptor concentrations and irradiation rates I. The radical concentration is several orders of magnitude higher in a very small part of the solution occupied by spurs. Calculations based on the above considerations showed that radiolysis of aqueous solutions by hard γ rays and fast electrons can be quantitatively described with the aid of a simplified model according to which radicals and molecular products are generated in constant yield throughout the entire volume of the solution. The existence of experimentally determined I-correlations in the radiolysis of some aqueous solutions is proof that the active particles in such solutions are radicals rather than excited water molecules. (auth)

40896 VVEDENIE V RADIATSIONNUYU KHIMIYU. (Introduction to Radiation Chemistry). I. V. Vereshchinskii and A. K. Pikaev. Moscow, Publishing House of the Academy of Sciences, 1963. 408p.

Results of 1500 experiments are analyzed and regularities and properties of radiochemical reactions in solids, fluids, and gases are reviewed. 238 references. (R.V.J.)

40897 RADIATSIONNYE EFFEKTY V SUL'FIDE KADMIYA. (Radiation Effects on Cadmium Sulfides). S. V. Starodubtsev, O. R. Niyazova, and A. E. Kiv. Tashkend, Publishing House of the Uzbek Academy of Sciences, 1963. 133p.

Physical properties of cadmium sulfide are discussed, and radiation effects on its electric conductivity and physical properties are evaluated. (R.V.J.)

40898 IRRADIATION OF POLYMERIC MATERIALS. Ayao Amemiya, Yoichi Okada, and Takao Ito. British Patent 939,096. Oct. 9, 1963. Priority date Nov. 15, 1960, Japan.

A process for radioinduced crosslinking in polyethylene, polystyrene, polypropylene, polyamides, polyester, polyacrylic ester, polylvinyl chloride, and natural and synthetic rubber is presented. The irradiation is effected in the presence of nitrous oxide, which eliminates any crosslinking-inhibiting effect and promotes crosslinking. It is assumed that nitrous oxide decomposes by the action of the ionizing radiation to form a free radical or ion that activates the neighboring molecule of the high polymer compound to effect the formation of new crosslinking . (C.E.S.)

40899 PRODUCTION OF POLYOXYMETHYLENE. (to Kanegafuchi Spinning Co. Ltd.). British Patent 939,475. Oct. 16, 1963. Priority date Mar. 16, 1961, Japan.

A process is described for preparing polyoxymethylene by irradiation of solid trioxane with ionizing radiation at a temperature of not more than 30°C and then, or at some later time, maintaining the irradiated trioxane at a temperature of from 50 to 60°C for more than 30 min. The trioxane is irradiated with a total dose of 1×10^5 to 5×10^6 r. (M.C.G.)

40900 PROCESS FOR THE PRODUCTION OF POLYFORMALDEHYDE. (to Houilleres du Bassin du Nord et du Pas-de-Calais). British Patent 939,498. Oct. 16, 1963. Priority date Jan. 24, 1961, France.

A process for the production of polyoxymethylene is described and examples given. Trioxane containing from 100 to 5000 ppm polar impurities (not including antioxidants) is subjected to ionizing radiation at a temperature of from 10 to 1°C below its melting point. The impure trioxane thus activated is allowed to polymerise in the solid state at a temperature of from 40 to 1°C below its melting point. The irradiation dose is less than 5000 rad per 1% conversion. (M.C.G.)

40901 IMPROVEMENTS IN METHODS FOR THE PRODUCTION OF IODINE 131 FROM TELLURIUM COM-

POUNDS. (to Commissariat a l'Energie Atomique). French Patent 1,262,615. Apr. 24, 1961. Filed Apr. 15, 1960.

Neutron irradiated $Te^{130}O_2$, containing I^{131} through decay of Te^{131}, is dissolved in 10% NaOH to give a 6–7% solution of the alkali tellurite. The tellurite is then oxidized to tellurate with H_2O_2 and Na_2MoO_4, the solution is acidified, and the I^{131} distilled. A scheme of the separation apparatus is given. (NPO)

40902 PROCESS FOR POLYMERIZING UNSATURATED ALDEHYDES USING IONIZING RADIATION AND RESULTING POLYMERS. Edward R. Bell, Vincent A. Capanile, and Elliot Bergman (to Shell Oil Co.). U. S. Patent 3,105,801. Oct. 1, 1963. Filed Oct. 21, 1960.

A method is described for polymerizing acrolein (CH_2:CHCHO) or α-methylacrolein, by exposing an aqueous solution of these compounds containing 0.001 to 20% of an acid to 10^5 to 10^8 rad of protons, electrons, or x rays at 0 to 100°C. The acid used may be sulfuric, phosphoric, or p-toluenesulfonic. The aqueous medium also contains a non-ionic surface-active agent. The conditions are described under which an acrolein polymer may be formed that is soluble in SO_2 and sodium bisulfite. (T.F.H.)

40903 SYNTHESIS OF FATTY ACIDS. Charles E. Stoops (to Phillips Petroleum Co.). U. S. Patent 3,105,802. Oct. 1, 1963. Filed Dec. 29, 1958.

A process is described for producing fatty acids having more than 2 C atoms. Acetic acid and ethylene are mixed and exposed to 10^5 to 10^{11} rep of ionizing radiation at a dose rate of 10^3 to 10^{10} rep/hr. The radiation used has an energy over 200 kev. The irradiation is carried out below 300 psia. (T.F.H.)

40904 RADIOACTIVE IODINE PROCESS. Geoffrey Irving Gleason (to Abbott Labs.). U. S. Patent 3,107,155. Oct. 15, 1963. Filed June 23, 1960.

A method for the separation of I^{131} from neutron-irradiated tellurium is presented. The irradiated tellurium is added to sulfuric acid, and then hydrogen peroxide is added to this mixture to initiate a spontaneous reaction. After the reaction is terminated heat is applied to the mixture to distill the I^{131} into a solution of sodium sulfite wherein the I^{131} is reduced to a convenient sodium iodide form. (C.E.S.)

40905 PROCESS FOR THE PRODUCTION OF SHAPED ARTICLES BY IRRADIATION. Emile Clement Cottet and Andre Claude Ducros (to Societe des Usines Chimiques). U. S. Patent 3,107,207. Oct. 15, 1963. Priority date Nov. 16, 1957, France.

A process applicable to the manufacture of sheets, tubes, and strips of methacrylic derivatives is presented. A crude or shaped stem polymer is impregnated with a quantity of methyl methacrylate at least equal to the weight of the polymer. The softened mixture obtained is subjected to polymerization at ambient temperatures under the action of electromagnetic or ionizing radiation. The polymerization may be effected either during or after the shaping of the softened mixture. (C.E.S.)

40906 PRODUCTION OF POLYFORMALDEHYDE. Claude Chachaty (to Houilleres du Bassin du Nord et du Pas-de-Calais). U. S. Patent 3,107,208. Oct. 15, 1963. Priority date Dec. 28, 1959, France.

The production of polyformaldehyde by subjecting formaldehyde, in the absence of a catalyst, to ionizing radiation at a temperature below −60°C is described. At temperatures below −60°C a series of temperature zones were distinguished in which the conditions most favorable for polymerization by irradiation differ substantially. (C.E.S.)

Raw Materials and Feed Materials

40907 (IEA-55) A OBTENÇÃO DE UF_4 FOR VIA ÚMIDA E SUA ADAPTAÇÃO AO ESQUEMA DO IEA. (Production of UF_4 by Wet Methods and its Adaptation to the IEA Procedure). Almir Augusto Laranja (Brazil, Instituto de Energia Atomica, São Paulo). Nov. 1962. 22p.

Studies on the adaptation of the wet method for the production of UF_4 to the ion exchange purification of uranyl sulfate in the presence of ammonium sulfate were presented. The reduction of U^{4+} is done electrolytically and UNH_4F_5 is purified with HF. The ideal elution interval was determined for this process from the data on the optimum conditions for reduction and precipitation and on the composition of the effluent. Improvement of the product obtained by decreasing the concentration of the coprecipitated uranium fluoride and sulfate was also studied. The utilization of 0.4 M ammonium fluoride was proposed for the elimination of these impurities. The double fluoride produced, although it has a low density, has a large specific area. The purified and anhydrous product is transformed into UF_4 by thermal decomposition. (auth)

40908 URANIUM. Atomics, 16: 11-26(Sept.-Oct. 1963).

The status of uranium supply, including resources, production, market, and long-range outlook, is reviewed. The development of the uranium market and the future of the uranium mining and milling industry are included. (P.C.H.)

40909 CONCENTRATION OF IRON NEAR THE CATHODE DURING ELECTROREFINING OF URANIUM IN FUSED-SALT BATHS. G. Chauvin, H. Coriou, and A. Simenauer (CEN, Saclay, France). Electrochim. Acta, 8: No. 5, 323-32(May 1963). (In French)

During electrorefining, impurities, notably Fe, are found to concentrate in the layer of electrolyte next to the cathode. The layer of electrolyte affected is about 100 μ thick, and the Fe concentration increases by a factor of about 100, from the external part of the layer to the surface of the cathode (i.e., the surface of the dendrites of refined U). The results are shown to have some relevance to knowledge of the general mechanism of electrorefining. Thus one can explain, for example, why the purity of the refined U depends, as often observed, on the quantity of residual electrolyte occluded in the dendrites after the final washing used to eliminate salts. (auth)

40910 ACID LEACHING OF URANIUM FROM SOME SOUTH DAKOTA LIGNITES. Shiou-chuan Sun and J. W. Fetterman (Pennsylvania State Univ., University Park and Pennsylvania and New Jersey Zinc Co., Palmerton). Indian J. Technol., 1: 120-3(Mar. 1963).

The effect of different variables, such as acid concentration, leaching time, oxidation, rate and mode of agitation, temperature, and pulp density on the recovery of uranium from three samples of uranium-bearing lignites from South Dakota with high, intermediate, and low uranium contents was studied. The recovery of uranium increases with increase in acid concentration, leaching time, extent of aeration, and rate of agitation. Addition of 1.0 mole per litre of H_2O_2, $KMnO_4$, or MnO_2 into the leaching pulp raises the uranium recovery to 95%. (auth)

40911 DESCRIPTION OF AN INSTALLATION FOR THE PRODUCTION OF URANIUM TRIOXIDE BY CAL-

CINATION IN FLUIDIZED BED OF SOLUTIONS OF URANYL NITRATE. A. Rodrigo Otero (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 7: No. 26, 4-14(Apr.-June 1963). (In Spanish)

The process is based on the almost instantaneous evaporation of saline solutions and the decomposition to the oxide, as rapidly as possible, of salts. These solutions are pulverized on preexistent particles of the corresponding oxides, maintained in great agitation and movement at the interior of a heated fluidized bed. Air is used as a fluidizing medium and is kept at temperatures between 300 and 350°C. The aims of the process are to obtain a uranium oxide with sufficient reactivity for subsequent processes and require an adequate control of the size of the oxide particles produced (80 to 400 microns). The essential parts of the calcination process are: the reactor; preheating of the fluidizing air; equipment for gas filtration; pulverizing system, a uranyl nitrate solution feed system; and oxide product collector. The pulverization system is the critical component of the system, and its production capacity is 350 kg/hr m^2 of an oxide of highly spherical particles. An evaporator to concentrate the uranyl nitrate solutions fed to the calcinator, and an absorber of the gases produced in the calcination complete the equipment. (tr-auth)

40912 SOLID AND LIQUID WASTES AT THE NINGYO-TOGE MINE. H. Misawa, K. Kanazawa, M. Maruyama, T. Segawa, and T. Ashizawa (Atomic Fuel Corp., Tokyo). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/3, 46p. (CONF-104-5)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Concentrations of U and Ra^{226} in surface mine water from prospecting tunnels of the Ningyo-toge mine were determined. Behavior of U and Ra^{226} in the milling process was investigated experimentally using the flowsheet of the proposed milling pilot plant. Experimental results indicate that concentrations of U and Ra^{226} in liquid wastes would be 10 to 20 mg/l and 10^{-7} to 10^{-8} μC/ml, respectively. The concentrations would decrease below 5 mg/l and below 10^{-8} μC/ml after neutralization by lime. Solid wastes contain only about 0.01% of U_3O_8. Apparently the solid and liquid wastes treated with lime will have little influence on the environment. (M.P.G.)

40913 NATURE, VOLUME, AND ACTIVITY OF URANIUM MILL WASTES. E. C. Tsivoglou and R. L. O'Connell (Robert A. Taft Sanitary Engineering Center, Cincinnati). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/46, 34p. (CONF-104-34)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

A series of intensive and detailed in-plant surveys of 6 American U mills was conducted for the specific purpose of characterizing the waste products of this industry. These surveys were designed to permit evaluation of the exact qualitative and quantitative nature of the waste flows to be expected from each of the types of U extraction processes commonly encountered. Starting with the ore as it enters the mill, a materials balance was made at each major processing step to account for the liquid, solids, chemical, and radioactive contents of the process flows. The process step at which each waste originates or becomes an important component was identified. Accurate mill balances for Ra^{226} were made. It is shown that at specific process points the Ra^{226} content is a quite consistent fraction of the gross α radioactivity, a highly valuable fact for purposes of routine process control. It was found that significantly greater quantities of Ra^{226} are dissolved in the alkaline leaching process than in acid leaching. However, subsequent process steps result in higher concentrations of dissolved Ra^{226} in the waste streams from the acid leach mills. The relative quantities of dissolved and suspended Ra^{226} in wastes from the various processes, and the effects of waste impoundments, waste recirculation, and neutralization are described. The fish bioassay was used to characterize the chemical toxicity of the various mill effluents and process streams and proved an extremely valuable technique. It was possible to compute reliable estimates of the extent to which waste flows must be diluted by the receiving river in order to prevent adverse effects on the aquatic biota. (M.P.G.)

40914 THE ANALYSIS OF EFFLUENTS AND ENVIRONMENTAL SAMPLES FROM URANIUM MILLS AND OF BIOLOGICAL SAMPLES FROM URANIUM, RADIUM, AND POLONIUM. D. E. Rushing (Publich Health Service, Salt Lake City). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/44. 15p. (CONF-104-32)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Fluorometric methods for determination of U have sensitivities of the order of 10^{-10} to 10^{-12} g U and are simple for certain types of samples (e.g., U ore dust, urine, water), but separations are needed for other types of samples (e.g., blood, certain silicates). Po can be determined by electrochemical displacement on many metallic surfaces. For more complex substances, such as mill process solutions or effluents, separations may be required. Ra-226 is almost invariably determined by α counting the Ra-226 (plus its decay products) or the Rn-222 (plus its decay products). Both methods are satisfactory if only Ra-226 is present in the preparation counted. Unfortunately, the isotopes of Ra (Ra^{223}, Ra^{224}, and Ra^{228}) interfere even if all other radionuclides are eliminated from the counted sample. Isotopic interferences in emanation methods (measuring the amount of Rn produced by Ra) are very much less serious than in the direct Ra methods. A method for the determination of Ra in silicates is described in detail. (M.P.G.)

40915 PROCESS AND APPARATUS FOR GRADING RADIOACTIVE ORES. Andre Laforet (to Commissariat à l'Energie Atomique). British Patent 939,537. Oct. 16, 1963. Priority date Apr. 25, 1960, France.

A process for grading radioactive ores or objects passing through the field of a radiation detector, with discrimination carried out as a function of the mean radioactivity of the ore or objects in the field of the radiation detector, is described. Grading is carried out automatically as a function of a definite threshold of radioactivity, which is manually adjusted to a mean value. A conveyor belt runs beneath the detector and the pulses delivered by the detector are transformed, when a fixed threshold of radioactivity is exceeded, into signals capable of operating a separator device (pneumatic jack). Separation is effected at the end of the conveyor belt by operation of a flap that is controlled by the jack and which deflects the path of the elements as they fall. (M.C.G.)

40916 METHOD FOR CHEMICAL REPROCESSING WATERY URANIUM SOLUTIONS CONTAINING MOLYBDENUM. James L. Drobnick and Clifford J. Lewis (to General Mills, Inc.). German Patent 1,150,963. July 4, 1963. Priority date June 5, 1959, United States.

A method is described for chemical reprocessing of watery solutions of uranium containing molybdenum. Watery solutions of this type are obtained when treating uranium ores with mineral acids. The method comprises the steps of extracting the uranium content by applying a solution of secondary or tertiary alkylamine in organic solvents and then of separating the uranium from the amine solution with the help of a watery acidized salt solution. Before separating the uranium the amine extract is treated with a reducing agent so that the molybdenum contained in the solution in the form of molybdate is reduced to a valency level from which it cannot form molybdenum-amine-complexes. Sodium sulfide or sodium thiosulphate(hydrosulfite) are preferably used as reducing agents. (Gmelin Inst.)

Separation Processes

40917 (AD-288767) A STUDY OF ANION EXCHANGE SEPARATIONS OF METALS WITH TARTARIC ACID (thesis). Gerald F. Pitstick (Ohio State Univ., Columbus). 1962. 93p.

A study was made to determine the feasibility of performing anion exchange separations of Cu^{2+}, Fe^{3+}, Mn^{2+}, Co^{2+}, and Zn^{2+}, using tartaric acid as a complexing agent. Radioisotopes of the five metals were used, and Dowex 2-X8 was used as the anion exchange material. The distribution coefficients were measured in batch-type experiments as a function of tartrate concentration and pH, and then used to select the proper conditions for chromatographic column separations. Several fairly rapid, clean separations of the metals were obtained. (D.L.C.)

40918 (AE-120) THE THERMOX PROCESS. O. Tjaelldin (Aktiebolaget Atomenergi, Stockholm). Sept. 1963. 38p.

The Thermox process is a process developed for the decladding and dissolution of irradiated Zircaloy-2-clad uranium dioxide fuel elements and consists of the following stages: 1. Decladding by means of thermal oxidation of the Zircaloy-2 with oxygen and water vapor at 825°C using nitrogen as a catalyst. 2. Oxidation of the uranium dioxide pellets with air and oxygen to U_3O_8 at a temperature of 450 to 650°C. Dissolving and leaching the uranium oxides with dilute nitric acid leaving the insoluble zirconium oxide as a residue. 4. Filtering the solution and washing the residues of the cladding. The work has included the following parts: the laboratory scale investigation of the conditions for the oxidation of Zircaloy-2 in various gas mixtures and of the conditions for oxidizing and dissolving sintered UO_2 pellets: the development on a pilot plant scale of suitable apparatus and process techniques for the safe and reproducible treatment of half length inactive fuel elements; and studies of some special operation and handling problems, which have to be solved before the method can be applied in full scale. Five half length fuel elements have been treated, and the results have been satisfactory. The pilot plant experiments have proved that inactive fuel elements can be decanned, oxidized, and dissolved by means of the Thermox process. Solutions and canning residues are easy to filter, separate, and handle and are free from corroding agents. The uranium losses can be kept very low. The zirconium dioxide is obtained in a form suitable for permanent disposal. (auth)

40919 (AERE-R-4381) MIXER-SETTLER RUNS TO STUDY URANIUM(IV) AS A REDUCTANT IN URANIUM/PLUTONIUM SEPARATION. H. A. C. McKay, R. J. W. Streeton, and A. G. Wain (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Sept. 1963. 49p.

Mixer-settler runs were carried out to study the use of hydrazine-stabilized uranium(IV) nitrate solutions to reduce plutonium in the uranium-plutonium separation in TBP processes. Concentration profiles for nitric acid, uranium(VI), uranium(IV), and plutonium were determined, and material balances and decontamination factors were calculated. Some relevant partition coefficients were measured. Information was also obtained on the kinetics of the uranium(IV)–plutonium(IV) reaction, of the aerial oxidation of uranium(IV) at low acidities in the TBP phase, and of reoxidation of plutonium(III) in the aqueous phase at acidities above 2.5 M. It was shown that the Wall mixer-settler used only operated at about 50% stage efficiency under the conditions of the runs. The implications of the results for flowsheet design were indicated. (auth)

40920 (ANL-6696) SMALL-SCALE DEMONSTRATION OF THE MELT REFINING OF HIGHLY IRRADIATED URANIUM–FISSIUM ALLOY. V. G. Trice, Jr., and R. K. Steunenberg (Argonne National Lab., Ill.). Aug. 1963. Contract W-31-109-eng-38. 44p.

Five melt refining demonstration experiments were conducted with highly irradiated EBR-II prototype fuel to verify earlier data on fission product removals obtained with unirradiated and low-activity alloys. In each experiment, approximately 0.4 kg of uranium-fissium fuel pins irradiated to burnups ranging from 0.22 to 1.75 total atom percent was melt refined for 1 or 3 hr at 1400 C in a lime-stabilized zirconia crucible. The behavior of fission products was consistent with the earlier results. Fission product removals were over 99 per cent for krypton, xenon, iodine, cesium, barium, and strontium, over 95 percent for yttrium, rare earths, and tellurium, and zero for the noble metals. Because of the small scale of the experiments and necessary exposure of the irradiated fuel to air in the cave facility, it was not possible to obtain definitive data on product yields. Swelling of the fuel pins and the associated release of fission product gases during the heating cycle caused no difficulty in the melt refining process on this scale. (auth)

40921 (CONF-14-42) Co-ION UPTAKE BY A BEAD-TYPE CATION-EXCHANGE RESIN. Harold F. Walton, Stein Deron, and C. P. Savariar (Colorado. Univ., Boulder). [1963]. Contract AT(11-1)-499. 17p.

From American Chemical Society 144th National Meeting, Los Angeles, Mar. 1963.

The sorption of chloride and bromide salts of bead-type cation-exchange resins in the sodium and barium form was measured over a wide range of concentrations using radioactive tracers. A flow technique was used to eliminate the effect of superficially adherent solution. The results can be interpreted by an internal heterogeneity, or a range of fixed-ion concentrations within the resin. (auth)

40922 (DP-417) RECOVERY OF Np^{237} AND Pu^{238} FROM IRRADIATED NEPTUNIUM OXIDE. Glenn A. Burney and Charles A. Prohaska (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Nov. 1959. Contract AT(07-2)-1. 13p.

An ion exchange process was demonstrated for the recovery of Pu^{238} from irradiated neptunium oxide. Three cycles of anion exchange proved adequate for the removal of fission products and for the separation of the neptunium and plutonium from each other. (auth)

40923 (DP-453) RECOVERY OF NEPTUNIUM FROM PUREX WASTE BY AN AGITATED BED OF ANION EXCHANGE RESIN. William E. Prout and LeVerne P. Fernandez (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Feb. 1960. Contract AT(07-2)-1. 18p.

Data are presented for the absorption of thorium and neptunium from synthetic waste concentrate of the "Purex" process by a miniature agitated bed of anion exchange resin. The behavior of neptunium indicated that efficient recovery should be obtained from Purex high activity waste concentrate by this technique. A method was developed for calculating absorption losses from agitated beds of resin. The predicted losses were in excellent agreement with experimental results. (auth)

40924 (DP-531) ANION EXCHANGE OF NEPTUNIUM IN NITRATE SOLUTIONS. Glenn A. Burney (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Dec. 1960. Contract AT(07-2)-1. 20p.

The absorption and elution of the anionic nitrate complex of neptunium(IV) were studied with several anion exchange resins and under a wide variety of conditions. (auth)

40925 (DP-689) SEPARATION OF NEPTUNIUM AND PLUTONIUM BY ANION EXCHANGE. Glenn A. Burney (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Apr. 1962. Contract AT(07-2)-1. 33p.

The separation of neptunium and plutonium by anion exchange in nitrate solutions was studied under a wide variety of experimental conditions. A method of separation was developed that is adaptable to remote operation in the plant. In the method, Np(IV) and Pu(IV) are absorbed on an anion exchange resin from 8M nitrate solution. The column is washed with 8M HNO_3 to remove contaminants; then the Pu is removed as Pu(III) by washing the column with HNO_3 containing ferrous sulfamate and hydrazine. Finally, the Np is eluted with dilute HNO_3. (auth)

40926 (DP-719) A FACILITY FOR CHEMICAL SEPARATION OF Pu^{238}. Arthur L. Coogler and Bill F. Fowler (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 1962. Contract AT(07-2)-1. 36p.

A facility for separation of Pu^{238} and Np^{237} from irradiated neptunium dioxide target slugs was designed, constructed, and operated at the Savannah River Laboratory. A description is given of the facility and the design details of equipment. (auth)

40927 (DP-729) CHEMICAL PROCESSING OF Pu^{238}. Ralph N. Tetzlaff (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1962. Contract AT(07-2)-1. 30p.

Plutonium (principally Pu^{238}) was separated from neptunium, and both the plutonium and neptunium were purified from fission products and cations by a three-cycle anion exchange process. (auth)

40928 (IDO-14610) CONCEPTUAL STUDY OF A SYSTEM FOR RADIOACTIVE DEMONSTRATION OF THE CHOP-LEACH PROCESS. PART I. A PRELIMINARY STUDY OF THE RADIOACTIVE DEMONSTRATION OF THE CHOP-LEACH PROCESS AT ICPP. J. A. Buckham and R. S. P'Pool (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). PART II. CONCEPTUAL STUDY OF CHOP-LEACH DEMONSTRATION FACILITY FOR PHILLIPS PETROLEUM COMPANY. R. G. Pitkin (Vitro Engineering Co., New York). Aug. 9, 1963. Contract AT(10-1)-205, Subcontract C-237. 87p.

The chop-leach process is a method for reprocessing power reactor fuels of low enrichment. A summary is given of the conceptual design work carried out on the proposed demonstration of the chop-leach process using irradiated fuel. Part I discusses the objectives, purposes, and requirements of the demonstration. The operations and ORNL equipment are described. Part II describes in detail three possible installation concepts for the demonstration. Process design assumptions, design concepts, and cost estimates are given. (D.L.C.)

40929 (KAPL-1306(Del.)) THOREX PROCESS DEVELOPMENT AT KAPL. W. O. Haas, Jr. and D. J. Smith (Knolls Atomic Power Lab., Schenectady, N. Y.). May 1956. Contract W-31-109-eng-52. 67p.

40930 (ORNL-TM-581) CHEMICAL TECHNOLOGY DIVISION. UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, FEBRUARY 1963. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Oct. 7, 1963. Contract W-7405-eng-26. 55p.

Development of a shear and leach complex for UO_2-SS clad fuel was continued with major emphasis on the operation of a rotary drum leacher. Flooding data for nozzle plate pulse columns at high A/O ratios are reported. Engineering tests of dissolution of Zr–6% U alloy with HF in molten salt demonstrated a dissolution rate of 0.8 to 1.5 mg/cm^2/min. Subsequent fluorination with 100% F_2 proceeded at half times of 40 to 135 min. The results of a high level waste calcination (run R-72) made with formaldehyde treated simulated Purex waste are reported. (auth)

40931 (ORNL-TM-613) CHEMICAL TECHNOLOGY DIVISION. UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, MAY 1963. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Oct. 20, 1963. Contract W-7405-eng-26. 54p.

The method of calculating the efficiency of Stacked Clone Contactors was revised to include a more accurate equilibrium equation, which is used in a computer program to calculate efficiency from the many data generated by the contactor. Theoretical equations derived from a model developed for the flow of liquid in foam for the countercurrent and drainage sections of foam separation columns were confirmed experimentally. High level waste processing run R-75 using simulated FTW-65 waste was made with addition of calcium nitrate to maintain constant mole ratio of calcium to sulfate which resulted in low sulfate volatility and low corrosion of the calciner. (auth)

40932 PRECIPITATION CHROMATOGRAPHY. SEPARATION OF METALS AS FERROCYANIDES ON FILTER PAPER. Adele M. Limatta and James D. Spain (Michigan Coll. of Mining and Tech., Houghton). Anal. Chem., 35: 1898-1900(Nov. 1963).

When a mixture of certain metal ions is allowed to flow from a capillary tube onto a piece of filter paper impregnated with a precipitating agent such as manganese ferrocyanide, concentric rings of metal precipitate develop. The rings form in the order of increasing solubility, since more soluble precipitates will form only after the metal ions of a less soluble one are exhausted by the precipitation process. A procedure for separation and identification of 11 ions that form insoluble ferrocyanides is described. If the precipitant is dispersed uniformly on the paper, then the area of the spot produced is proportional to the total number of equivalents of metal ion applied. A quantitative

procedure based on this principle is described and certain variables in the procedure are discussed. (auth)

40933 DISTRIBUTION OF ION PAIRS BETWEEN IMMISCIBLE NONAQUEOUS SOLVENTS. George W. Latimer, Jr. (Pittsburgh Plate Glass, Corpus Christi, Tex.). Anal. Chem., 35: 1983(Nov. 1963).

The extraction of ion pairs from diethyl ether by ethanolamine, formamide, and adiponitrile was investigated. For the most part, the degree and direction of extraction could be satisfactorily estimated from the color of the phases. Only Sn(IV) showed any preference whatsoever for the ether phase. Data are tabulated. (P.C.H.)

40934 EXTRACTION OF TETRAVALENT CERIUM WITH ORGANIC SOLVENTS. V. I. Levin. G. V. Korpusov, N. M. Man'ko, E. N. Patrusheva, N. P. Prokhorova, and G. F. Platnov. At. Energ. (USSR), 15: 138-46(Aug. 1963). (In Russian)

The currently used methods for separating Ce from the trivalent rare earth elements are based on its oxidation to the tetravalent state, followed by a second separation step. In view of the effectiveness of the extraction by organic solvents, the problems involved in the extraction of microamounts of radioactive Ce were studied, using Ce^{144} as tracer and $NaBrO_3$, $KBrO_3$, $KClO_3$, ozone, HNO_3, and anodic oxidation as oxidizing agents. Ozone was found to be most reliable because it is not affected by the contamination of the solution with extraneous ions. As extracting agents, diethyl ether, nitromethane, and tributyl phosphate were investigated. The first solvent was found to extract the Ce as the saturated ceric acid $H_2[Ce(NO_3)_6]$. The other two agents extract the Ce as the nitrate $Ce(NO_3)_4$ when the HNO_3 concentration is kept low; at high nitric acid concentrations the Ce is again extracted as ceric acid. If the nitric acid concentration in the aqueous phase exceeds the value of 2N, the molar ratio of $Ce(NO_3)_4$ and HNO_3 in the organic phase will approach 1:2, corresponding to $H_2[Ce(NO_3)_6]$. The constant of complex formation of the reaction of Ce(IV) with the nitrate ion was also calculated. (TTT)

40935 STUDIES OF THE SOLVENT EXTRACTION OF ZIRCONIUM-95 IN THE TRIBENZYLAMINE-HYDROCHLORIC ACID SYSTEM. Takashi Omori and Nobuo Suzuki (Tohoku Univ., Sendai). Bull. Chem. Soc. Japan, 36: 850-4 (July 1963). (In English)

The distribution of carrier-free Zr^{95} between HCl and tribenzylamine was investigated. The extraction process of Zr^{95} from hydrochloric acid solutions of tribenzylamine is shown to be $ZrCl_6^{2-} + 2RCl \rightleftharpoons R_2ZrCl_6 + 2Cl^-$ followed by the reaction of the above species with TBA-Cl in a chloroform solution: $R_2ZrCl_6 + 2RCl \rightleftharpoons R_2ZrCl_6 \cdot 2RCl$. The main extractable species of zirconium, $ZrCl_6^{2-}$, is formed from the zirconyl ions: $Zr(OH)_nCl_n^{(2-n)+} + 2H^+ + (6-n)Cl^- \rightleftharpoons ZrCl_6^{2-} + 2H_2O$. On the basis of the results and of previously reported data on niobium extraction, some information with respect to the optimum conditions for the separation of zirconium and niobium are also given. (P.C.H.)

40936 EQUILIBRIUM DISTRIBUTION OF URANYL NITRATE AND NITRIC ACID IN EXTRACTION WITH METHYLCYCLOHEXANONES FROM SOLUTIONS WITH ACID DEFICIT. O. Hornof and V. Šraier (Inst. for Research, Production, and Use of Isotopes, Prague and Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Řež). Collection Czech. Chem. Commun., 28: 2247-51 (Aug. 1963). (In German)

The distribution of uranyl nitrate and nitric acid for uranium concentrations of 0.1 to 2M, for a nitric acid deficit from 0.1 to 0.6 (acid deficit is defined as the ratio of the mol number of hydroxide added to uranyl nitrate solutions to the mol number of uranyl nitrate in the solution), and 5M NH_4NO_3 in the aqueous phase was followed in extraction with industrial methylcyclohexanone at 20, 40 (deficit 0.2) and 60°C (deficit 0.2 and 0.6). (tr-auth)

40937 EQUILIBRIUM DISTRIBUTION OF URANYL NITRATE AND NITRIC ACID IN EXTRACTION WITH METHYLCYCLOHEXANONE FROM ACID SOLUTION. F. Havlíček and V. Šraier (Inst. for Research, Production, and Use of Isotopes, Prague and Technical Univ., Prague). Collection Czech. Chem. Commun., 28: 2251-7(Aug. 1963). (In German)

The mutual effects of uranyl nitrate and nitric acid on their extraction from acid solution with methylcyclohexanone were investigated. The distribution of the nitric acid alone for acid concentrations from 0.1 to 4M was first determined. The distribution of uranyl nitrate and nitric acid for uranyl concentration up to 2M and nitric acid concentrations of 0.1, 0.25, 1.0, 2.0, and 4M without the addition of salting out agents and under the same conditions with 5M NH_4NO_3 in the aqueous phase was determined in the extraction with industrial methylcyclohexanone. The equations for the distribution of the HNO_3 alone and of uranyl nitrate under the conditions given and for the density of the aqueous phase were found. In the simultaneous extraction of uranyl nitrate and nitric acid, either the salting out effect of the second component or their concurrent extraction occurs according to the conditions. (tr-auth)

40938 ANION-EXCHANGE STUDIES ON THE SEPARATION OF URANIUM AND RARE EARTHS. N. S. Kunte and R. A. Singh (Atomic Energy Establishment, Trombay, India). J. Indian Chem. Soc., 40: 597-8(July 1963).

A method for the separation of uranium from rare earths by ion exchange is reported. Amberlite IRA-400 of mesh size 30 to 40 was used. The results show that U can be separated from Th and rare earths by the method, but the removal of Fe is not satisfactory. (P.C.H.)

40939 THE EXTRACTION OF LANTHANONS WITH ALKALI METAL AMALGAMS. III. STUDIES OF MODEL SYSTEMS. M. F. Barrett, D. Sweasey, and N. E. Topp (National Chemical Labs., Teddington, Middx, Eng.). J. Inorg. Nucl. Chem., 25: 1273-86(Oct. 1963).

The extraction of the lanthanon elements with alkali amalgams was examined. Seven of the lanthanon elements extract, and different efficiency sequences were found. The La–Nd group are extracted in the sequence Li > Na > K, while the Sm–Eu–Yb group extract in the order Na > K > Li. Divalent ions are formed during the extraction of the last three elements, and, when extracted from binary mixtures, the elements are enriched in the amalgam phase. The emf of a number of lanthan amalgam cells have been measured. They are all lower than the emf of the corresponding alkali amalgam cells. It is suggested that extraction is the sum of two opposing effects, electrochemical and hydrolytic. The evidence suggests that the La–Nd group are reduced by a three-electron reduction; while the Sm–Eu–Yb group are first reduced to the divalent state. (auth)

40940 A METHOD OF PURIFICATION OF PROTACTINIUM FROM NIOBIUM. A. J. Walter (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. Nucl. Chem., 25: 1301(Oct. 1963). (AERE-M-1165)

A method is described in which about 500 mg of protactinium containing 0.02% Nb can be obtained. Protactinium is precipitated from 8 N HCl/0.5 M HF as hydroxide and

then dissolved in 40 ml of 40% H_2SO_4. The container is packed around with ice and 20 ml of 100 vol hydrogen peroxide added, followed by enough ammonia to make the solution just alkaline to litmus. After standing for 2 hr the yellow peroxide precipitate is centrifuged off, washed twice with water and dissolved in cold, 40% H_2SO_4. After a second peroxide precipitation, 200 ppm Nb remains. (P.C.H.)

40941 INORGANIC EXTRACTION STUDIES ON THE SYSTEM OF SOME DIPHOSPHONATES-NITRIC ACID. TETRABUTYL METHYLENE-DIPHOSPHONATE AND TETRABUTYL ETHYLENE-DIPHOSPHONATE. Tomitaro Ishimori, Kan Kimura, Eiko Nakamura, Johkun Akatsu, and Toshiko Kobune (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 633-9(Aug. 1963). (In English)

A radiochemical study was made on the solvent extraction behavior of about sixty chemical elements in 10% TBEDP- and 10% TBMDP-nitric acid systems, respectively. The acidity of the aqueous phase was changed from 1 to 15N. The acid dependence curves obtained for each element were very similar between the two systems studied. Considerable regularities were found with respect to the extraction behavior of the corresponding congeners. It was also found that the results for both systems are fairly similar to those of 100% TBP-HNO_3 system. (auth)

40942 SEPARATION OF RARE EARTH ELEMENTS BY FOCUSSING CHROMATOGRAPHY. Yuichiro Kamemoto, Kimiko Hagiya, and Shigeru Yamagishi (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 652-6(Aug. 1963). (In Japanese)

Focusing chromatography was applied to the mutual separation of rare earth elements and the effect of several conditions upon the separation of rare earth elements was studied. The most satisfactory result was obtained when: 0.1M citric acid was used as the complexing agent and 0.01N hydrochloric acid as the decomplexing agent, pH gradient of both solutions between anode and cathode was pH 2.8(HCl)–4.4 (citric acid), the rare earth solutions contained no nitric acid, the applied voltage was 1000 v/30 cm, the treatment time was 20 min, and the filter paper was Toyo Roshi No. 50. After treatment of separation, the autoradiographic technique was employed to decide the position of each separated line. (auth)

40943 EXCHANGE ADSORPTION OF CESIUM ION BY CALCINED MONTMORILLONITE TABLET. Mutsumi Nishidoi. Nippon Genshiryoku Gakkaishi, 5: 729-34(Sept. 1963).

In order to use montmorillonite for ion exchange decontamination of radioactive cesium ion, the undesirable swelling characteristic of montmorillonite was improved by calcination above 700°C. The cation exchange capacity of the calcined exchanger was improved by treatment with sodium hydroxide, which was found to be more suitable than hydrochloric acid. The total exchange capacity of the new exchanger was measured in normal solution of cesium labeled with Cs^{137}. Exchange equilibria of Natural-, H-, and Na-form calcined exchangers are discussed taking calcination temperature and the kinds of chemicals into consideration. (P.C.H.)

40944 COUNTERCURRENT COMPUTATION ON TRINITRATE COMPLEX OF NITROSYLRUTHENIUM IN THE PRIMARY SEPARATION PLANT OF REACTOR FUEL PROCESSING. [PART] II. Masao Takigishi. Nippon Genshiryoku Gakkaishi, 5: 742-6(Sept. 1963).

The decontamination factor of penta and tetra complexes of nitrosylruthenium in the primary separation plant of irradiated reactor fuel processing was expressed as a complex function of reaction rate constants, number of stage, mixing time/bank, and the volume ratios of solvent, feed, and strip. The obtained equation may sufficiently express the significant interactions between them and it is shown that the most effective factor is the reaction rate constant and the total mixing time in the stripping section, the second is the volume flow ratios and the total mixing time in the extraction section, and the third is the mixing time at the feed stage. It was also demonstrated from the calculation results that the mixing time may be remarkably decreased by further repeating the decontamination process. The stripping mixing time should be finally decided from the enrichment of reactor fuel, considering the criticality and the capacity of effluent treatments. (auth)

40945 STUDIES ON REMOVAL OF RADIOACTIVE MIST BY PLATE COLUMN. Tokuro Mizushina, Takeichiro Takamatsu, Nobuo Mitsuishi, Tsutomu Fukumoto, and Tomosaburo Mori (Kyoto Univ.). Nippon Genshiryoku Gakkaishi, 5: 747-53(Sept. 1963). (In Japanese)

Studies were made on the separation of radioactive droplets by a plate column during the evaporation of radioactive wastes, and it was found that droplets entrained in the evaporating vapor or formed on trays and carried by the vapor are not completely eliminated at trays above, but that some of them pass through the trays. The results of the studies on the effects of the number of trays, the reflux ratio, the quantity of the entrained droplets, and the probability of their passing through a tray on the decontamination factor, (D.F.), are reported, along with the method of evaluating the number of trays required for a prescribed (D.F.), given a reflux ratio, a quantity of entrained droplets, and a probability of their passing through. (P.C.H.)

40946 METHODS FOR OBTAINING ANALYTICAL URANIUM CONCENTRATES. A. K. Babko and V. N. Danilova (Inst. of General and Inorganic Chemistry, Kiev). Zh. Analit. Khim., 18: 1036-41(Sept. 1963). (In Russian)

A study was made of dry and wet combustion of an analytical concentrate containing 5×10^{-9} to 1×10^{-8} g of uranyl in an organic carrier. It is shown that losses of the microconstituent as aerosols take place during dry combustion; the losses can be eliminated by adding an inorganic carrier (sodium chloride). No uranyl losses are observed on wet combustion. A comparison was made of the sensitivity of methods for uranyl coprecipitation and extraction with diantipyrylmethane thiocyanate, as well as for uranyl coprecipitation with crystal voilet thiocyanate. Optimum conditions were found for the separation and determination down to 2×10^{-9} g of uranyl by its extraction as uranyl-thiocyanate-diantipyrilmethane. (auth)

40947 THE INFLUENCE OF THE COMPOSITION OF MIXTURES OF ESTERS WITH KETONES AND ALCOHOLS ON THE SEPARATION OF CERTAIN RARE EARTHS BY A PAPER CHROMATOGRAPHIC METHOD. M. E. Vdovenko (Inst. of General and Inorganic Chemistry, Kiev). Zh. Analit. Khim., 18: 1063-70(Sept. 1963). (In Russian)

A study was made of the chromatographic separation of rare earths with ester-containing mixtures. Optimum conditions were established for lanthanum, neodymium, and yttrium separation depending on the solvent composition. It was found that acetone–ester mixtures can be satisfactorily used for separating the cerium group of elements. Taking lanthanum thiocyanate as an example, it is shown that a solvent mixture for the partition chromatography of rare earths can be selected by means of the relation be-

tween the R_f value and the percent extraction of the substance into the solvent. (auth)

40948 A PROCESS AND AN APPARATUS FOR PURIFYING A GAS OR GAS MIXTURE CONTAMINATED BY ONE OR MORE RADIOACTIVE SUBSTANCES. (to Gesellschaft fur Linde's Eismaschinen AG Zweigniederlassung Hollriegelskreuth). British Patent 939,980. Oct. 16, 1963. Priority date Dec. 2, 1958, Germany.

A method is described for purifying gases contaminated by radioactive materials, particularly gases used in gas-cooled reactors such as helium and neon for cooling and protective purposes. The method was developed to prevent the purification process from becoming a source of radioactive contamination to personnel. A low-temperature sorption device is used. Purified gas serves as protective gas atmosphere for the part of the plant containing the contaminated gas. (M.C.G.)

40949 METHOD FOR SEPARATING URANIUM FROM DEPLETED, URANIUM, ZIRCONIUM, AND FISSION PRODUCTS CONTAINING URANIUM FUEL ELEMENTS. Lorans Pendleton Hatch, William Henry Regan, Jr., and James Joseph Reilly (to U. S. Atomic Energy Commission). German Patent 1,152,096. Aug. 1, 1963. Priority date Apr. 6, 1959, United States.

A method is described for recovering uranium from depleted zirconium and fission-products containing uranium fuel elements by converting zirconium into zirconium tetrachloride and uranium into uranium hexafluoride. The method comprises the steps of converting the uranium fuel element in a reaction vessel with gaseous hydrochloric acid by locating it within a zone of high turbulence of aluminum oxide, removing the formed zirconium tetrachloride, introducing gaseous fluorine into the reaction vessel, and extracting the uranium hexafluoride. (Gmelin Inst.)

40950 SEPARATION OF PROTACTINIUM FROM MOLTEN SALT REACTOR FUEL COMPOSITIONS. J. H. Shaffer, J. E. Strain, D. R. Cuneo, and M. J. Kelly (to U. S. Atomic Energy Commission). U. S. Patent 3,110,555. Nov. 12, 1963.

A method for selectively precipitating protactinium from a neutron-irradiated fused fluoride salt composition comprising at least one metal fluoride selected from the group consisting of an alkali metal fluoride and an alkaline earth metal fluoride containing dissolved thorium-232 values is presented. An inorganic metal oxide corresponding to any of the metal fluorides of the composition is also added. (AEC)

40951 PROCESS FOR SEPARATING YTTRIUM FROM THE RARE EARTHS BY SOLVENT EXTRACTION. Donald F. Peppard and George W. Mason (to U. S. Atomic Energy Commission). U. S. Patent 3,110,556. Nov. 12, 1963.

A process of isolating yttrium from other rare earths present together with it in aqueous solutions is presented. Yttrium and rare earths heavier than yttrium are first extracted with dialkyl phosphoric acid, after adjustment of the acidity to 2 N, and then back-extracted with 5-6 N mineral acid to form a strip solution. Thiocyanate is added to the strip solution and the rare earths heavier than yttrium are then selectively extracted with trialkyl phosphate, dialkyl phosphoric acid, alkyl phosphonate, or dialkyl aryl phosphonate, leaving the yttrium in the aqueous solution. (AEC)

40952 RECOVERY OF ACTINIDES FROM AQUEOUS NITRIC ACID SOLUTIONS. Milton Ader (to U. S. Atomic Energy Commission). U. S. Patent 3,111,374. Nov. 19, 1963.

A process of recovering actinides is presented. Tetravalent actinides are extracted from rare earths in an aqueous nitric acid solution with a ketone and back-extracted from the ketone into an aqueous medium. The aqueous actinide solution thus obtained, prior to concentration by boiling, is sparged with steam to reduce its ketone to a maximum content of 3 grams per liter. (AEC)

40953 REGENERATION OF HYDROCARBON SOLUTIONS OF TRIALKYL PHOSPHATE USED IN PROCESSING OF NUCLEAR FUEL. Charles W. Pollock and Theodore R. McKenzie (to U. S. Atomic Energy Commission). U. S. Patent 3,112,275. Nov. 26, 1963.

A process for removing zirconium, niobium, and ruthenium fission products and organic decomposition products from tributyl phosphate solutions by sorption on an aqueous magnesium hydroxide slurry is presented. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

40954 (ACNP-63028) STEAM SEPARATION TECHNOLOGY UNDER THE EURATOM PROGRAM. Quarterly Progress Report, July 1, 1963–September 30, 1963. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Oct. 10, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1186. 113p. (EURAEC-828)

Calibration of the liquid-level detector for steam-water facility is complete from 600 to 2000 psig. Permissible steam release rates for 24 and 36 inches above the interface are established for the test pressures. The correlation equation which relates steam void fraction to basic system parameters is further refined to include all the data from this program as well as from the low-pressure steam-water facility. By addition of another dimensionless term to the equation it is possible to extend the equation to include the radial gradient in the void fraction. Collection of carryunder in the downcomer region of the natural separation reactor mockup is complete. From this data it is possible to establish an equation for the downcomer slip ratio. The development of two types of upcomer separators is discussed: a small separator to fit over a fuel element or a group of elements, and a large separator to get over an entire core. The initial small separator under investigation is a centrifugal axial flow model. Results from this program are encouraging. The large upcomer models tested are of the double-helix type. Results with these separators are not encouraging, but data from the small separator program should provide useful information to aid the large separator design. Analysis of the test results from the 8-in. diameter centrifugal type downcomer separator is complete. The test provides a check on the equations used to scale from one size separator to another. It appears that the equations are conservative, predicting a lower capacity than the test shows. (auth)

40955 (CONF-39-100) THE STRENGTH OF THIN-WALLED CYLINDERS SUBJECTED TO DYNAMIC INTERNAL PRESSURES. C. J. Costantino (Illinois Inst. of Tech., Chicago. IIT Research Inst.). [1967]. Contract AT(11-1)-578. 16p.

From American Nuclear Society 9th Annual Meeting, Salt Lake City, June 1963.

The equation of motion governing the response of long (infinite) cylinders to dynamic internal pressures is derived. Since large displacements and wall thinning effects are taken into account, elastic behavior of the material is neglected. The material is assumed to be rigid-plastic, with strain-hardening being taken into account through the Ludwik power strain hardening law. Numerical results are presented for a range of hardening constants from 0.01 to 1.0, covering the range applicable to most materials of interest. The form of the dynamic pressure considered is an initally peaked, linearly decaying pressure pulse. Charts are presented giving the pressure and duration required to produce a given final radius of the cylinder. (auth)

40956 (DASA-1339) DYNAMIC SHEAR STRENGTH OF CONCRETE KEYS. Indravadan Shah (Massachusetts Inst. of Tech., Cambridge. School of Engineering). Jan. 1963. Contract DA-49-146-XZ-061. 61p. (AD-297927)

A research program was conducted to study the comparative behavior of shear keys under static and dynamic loading and to obtain information on the ultimate load carrying capacity of shear keys as influenced by various parameters, such as the aggregate strength, the number of keys, and the transverse compression on the shear section. The following categories of tests were made: (I) Specimens with the variation in the strength of coarse aggregate. (II) Specimens with keys under direct transverse compressive stress (50 psi). (III) Specimens with the variation in number of shear keys. All these three categories were tested for both static and dynamic loads, the dynamic loads simulating an initial peak triangular blast loading. These tests have shown that (1) plain concrete keys have a high strength in shear—of the order of 1000 psi under static loads and 1300 to 1700 psi under dynamic loads; (2) the use of stronger or weaker aggregate, compared to a normal aggregate seems to be beneficial for dynamic load cases; (3) the effect of transverse compression on shear strength of concrete is significant only when transverse compression is of the order of 300 psi; (4) the total strength of a joint does not increase in direct proportion to the number of shear keys. With the increase in the number of keys (in the direction of the load application) the average shear strength decreases; and (5) failure of shear keys is quite brittle in general for both static and dynamic loadings. (auth)

40957 (ORNL-TM-702) ORNL PUMP BROCHURE. Clayton D. Zerby (Oak Ridge National Lab., Tenn.). Oct. 15, 1963. Contract [W-7405-eng-26]. 10p.

The ORNL pump is a high suction pressure, high-temperature chemical pump capable of outputs up to 20 gpm at ~40 feet of water head. The pump will operate with a suction pressure from atmospheric to 1000 psi and circulate fluids at temperatures up to 250°C. The assembly, disassembly, and operation of the pump are described. Characteristic curves of the pump using standard and alternate electrical connections are given. (D.L.C.)

40958 (UCRL-7499) FREQUENCY RESPONSE OF A PHOTO-VISCOELASTIC MATERIAL. G. W. Brown (California. Univ., Berkeley. Lawrence Radiation Lab.) and D. R. Selway (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 15, 1963. Contract W-7405-eng-48. 26p. (CONF-262-1)

From Society for Experimental Stress Analysis Annual Meeting, Boston, Nov. 1963.

An electromagnetic shaker was used to apply sinusoidal axial displacements to one end of a column of Hysol 4364, an optically sensitive urethane rubber compound of low modulus. The nondriven end of the column was free. The column was excited at frequencies of 81, 244, 424, 603, and 783 cps, corresponding to the first five resonant frequencies of longitudinal vibration. Measurements were made of displacement mode shapes and phase angles, and birefringence modes and phase angles. Measured displacement modes and phase angles were shown to agree with predictions based on a linear one-dimensional viscoelastic theory. The measurements and theory were used to determine the mechanical and optical frequency response of the material for the experimental frequencies. This consisted of determining: the dynamic elastic modulus, the phase angle between stress and strain, the dynamic stress-optic coefficient, and the phase angle between stress and

birefringence. The elastic modulus increased continuously from the static value of 318 psi to 576 psi at 783 cps. The stress-strain phase angle increased from 9.3° at 81 cps to 11.9° at 783 cps. The stress-optic coefficient was essentially constant over the frequency range and equal to the static tension value, 1.03 psi/fringe/in. The stress-fringe phase angle appeared to be greater than the stress-strain phase angle by a constant 4° ± 2° which indicated that birefringence lagged both stress and strain for this material. (auth)

40959 TELECHIRICS— FOR OPERATIONS IN HOSTILE ENVIRONMENTS. John W. Clark. Battelle Tech. Rev., 12: No. 10, 3-8(Oct. 1963).

An effective approach is discussed for remotely carrying out tasks under human control in environments hostile to man. The approach consists of complex manipulatory tasks with mechanisms controlled electronically by a man far removed from the hostile environment. The system is called telechirics. In a telechiric system, on-line decisions are made by an operator who identifies himself with a remote set of tools that can be manipulated almost as though he were holding them in his hands. The design of a telechiric system involves four important preliminary steps: definition of the objective; analysis of the objective into tasks; trade-off studies; and logistics studies. All telechiric systems must have six major subsystems to accomplish their essential functions: manipulation, locomotion, sensing, command and data link, control console, and power supply. Each system is discussed separately along with applications of telechirics. (P.C.H.)

40960 THE EFFICIENCY OF MEMBRANE FILTERS. W. J. Megaw and R. D. Wiffen (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Intern. J. Air Water Pollution, 7: 501-9(Aug. 1963). (AERE-R-4211). (In English)

Experiments are described in which the efficiency of type AA Millipore filter was determined at a particle diameter of 0.02 microns, using aerosols of potassium permanganate and radioactive tungsten. No significant penetration of the filter was detected either by particle counting techniques using a Pollak counter or by radioactive methods. It is shown that the performance of the filter in this size range is not dependent on electrostatic effects and is predictable theoretically if it is assumed that diffusion is the sole filtration mechanism. Larger particles that are still smaller than the filter pores and for which diffusion processes are ineffective are also trapped with efficiencies of 100%. Removal of the electrostatic charge of the filter does not alter its efficiency and it was concluded that such particles must be trapped by impaction in the filter pores. (auth)

40961 TRIAL MANUFACTURE OF BISMUTH LOOP. Seishi Yajima, Yuichiro Kamemoto, and Yoshihisa Takahashi (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 672-6(Aug. 1963). (In Japanese)

The outline of the structure of a bismuth loop is given. The loop was charged with bismuth by pressurizing the sumptank with nitrogen gas. In operation, the bismuth was pumped by means of a mechanical pump to III, II, and I vessels and a flowmeter. The temperature of bismuth metal was controlled at 550°C (usual) and 700°C (maximum), and was read with chromel-alumel and platinum-platinum, rhodium thermocouples set in 28 points of this loop. Individual piping runs and vessels were wrapped with hot plates of nichrome heater. The total power supplied to groups of the heaters was maximum 20.12 kw. The pipe consisted of two parts. An inner tube (bismuth piping) was surrounded by hot plate of nichrome heater and an outer tube was surrounded by thermal insulator. In order to protect the inner tube from being oxidized by air, graphite powder was packed between the tubes and nitrogen gas was let flow through the powder. (P.C.H.)

40962 A LIQUID HYDROGEN REACTOR IRRADIATION DEVICE. L. Bochirol, J. Doulat, A. Lacaze, and L. Weil (CEN, Grenoble, France). 16p. (CONF-176-12)

From Cryogenic Engineering Conference, Boulder, Color., Aug. 1963.

A device allowing samples to be irradiated at 28°K in a swimming-pool nuclear reactor is described. The apparatus is refrigerated by means of a completely closed hydrogen circuit including a Joule-Thomson expansion liquefier, and the samples are immersed in a bath of liquid neon. The in-pile part of the loop can be moved, while operating, between the irradiation place and another position, about 1 meter aside, out of the radiation flux. Electrical measurements can be made on the samples, during irradiation or/and during controlled annealing which may take place after irradiation in the loop itself. The samples can be removed in the cold condition, for further measurements in the laboratory. The maximum refrigeration power of the device is about 150 watts, and this allows irradiation to be made in the Mélusine reactor in a neutron flux as high as 2×10^{13} nvt. Liquid hydrogen of the closed hydrogen circuit is used as a precoolant for a liquid helium irradiation device. (auth)

40963 HERMETIC ROTATABLE AND SLIDABLE REMOTE HANDLING DEVICE. (to European Atomic Energy Community). British Patent 939,121. Oct. 9, 1963. Priority date July 4, 1961, Belgium.

A remote handling device in the form of a bar having handles at one end and a tool holder at the other is presented. The bar is composed of two tubes and a rod nested one within the other and extending in sealed fashion through a shielding wall. A ball joint is disposed within the wall and the device is displaceable lengthwise by sliding the outer tube. The inner tube is rotatable to effect rotation of the tool and the rod is movable to operate the tool. The device is mainly distinguished in that the tool holder is subdivided into at least two aligned bodies, one of which is releasably fixed to the outer tube and the other releasably connected to the inner tube to prevent relative motion between them. (C.E.S.)

40964 CONSTANT-HEIGHT VERTICAL SUPPORT DEVICE, IN PARTICULAR FOR TANKS. (to Commissariat a l'Energie Atomique). British Patent 939,332. Oct. 9, 1963. Priority date Jan. 25, 1961, France.

A vertical pillar structure for transmitting a load from a tank to an anchoring structure is presented. A universal coupling and a series of load transmitting elements are so connected that some are subjected to tensile forces and others to compression forces. The elements are dimensioned so that the thermal expansions compensate one another and the tank is maintained at a constant level with respect to the anchor structure. (C.E.S.)

40965 IRRADIATION CONTAINER. (to Commissariat a l'Energie Atomique). French Patent 1,261,979. Apr. 17, 1961. Filed Apr. 13, 1960.

For irradiation inside a nuclear reactor, a sample container is provided comprising a tubular casing fluid-tight-closed by a cover. The sample is supported in a refractory inner casing forming annular interspaces between the outer

and the inner casing and the inner casing and the sample. This inner casing has lateral openings in the proximities of its upper and lower end. The innermost of the annular interspaces encloses a heater element that controls the temperature of the sample onto which thermocouples are fixed. Fluid-tight bushings are provided in the cover for the passage of conductors and fluid lines. (IIB)

40966 HANDLING DEVICE. (to Commissariat a l'Energie Atomique). French Patent 1,293,073. Apr. 2, 1962. Filed Mar. 28, 1961.

The handling device comprises two drums. On each drum is partially wound up a metal strip. At least one of these strips is provided with notches regularly distributed along its edges. A mechanism for assembling these two strips bends the second strip and introduces it between the folded up portions of the notches of the first strip. After the assemblage, the two strips form a flexible rod of adjustable length, which can be provided at its end with gripping means, adapted to be introduced into any arbitrary tubular system. (IIB)

40967 SELF-RELEASING GRAPPLING DEVICE. Dallas A. Hoover, Sr. (to U. S. Atomic Energy Commission). U. S. Patent 3,109,677. Nov. 5, 1963.

A self-releasing grappling device that lifts by virtue of engagement between clamping jaws and the undercut lower side of a conical head of a lifting lug attached to the object to be lifted and employs a releasing sleeve on the lug to free the jaws from the lug is presented. When the jaws are to be released, they are dropped over the releasing sleeve, which is located well below lug head. When the jaws are lifted, they engage a conical surface on the sleeve and lift it up to the head of the lifting lug. In this position of the sleeve, the lower side of the lug head is covered by the sleeve and so cannot be engaged by the jaws, which move past before clearing the sleeve. (AEC)

40968 FILTER FOR HIGH VELOCITY GAS STREAMS. Richard A. Heckman and Henry F. Warner (to U. S. Atomic Energy Commission). U. S. Patent 3,109,724. Nov. 5, 1963.

An air filter that is particularly useful in air-sampling rockets is presented. The filter comprises a cellulose fiber mat having an evenly disposed thin coating of stearic acid. Protective loose weave fabric covers are stitched to the front and back of the fiber mat, the stitching being in the form of a sine wave spiraled from the midpoint of the mat out to its periphery. (AEC)

40969 FLUID PRESSURE AND CAM OPERATED VACUUM VALVE. Thomas H. Batzer (to U. S. Atomic Energy Commission). U. S. Patent 3,112,095. Nov. 26, 1963.

An ultra-high vacuum valve that is bakable, reusable, and capable of being quickly opened and closed is described. A translationally movable valve gate having an annular ridge is adapted to contact an annular soft metal gasket disposed at the valve seat such that the soft metal gasket extends beyond the annular ridge on all sides. The valve gate is closed, by first laterally aligning the valve gate with the valve seat and then bringing the valve gate and valve seat into seating contact by the translational movement of a ramp-like wedging means that engages similar ramp-like structures at the base of the valve gate to force the valve gate into essentially pressureless contact with the annular soft metal gasket. This gasket is then pressurized from beneath by a fluid thereby effecting a vacuum tight seal between the gasket and the ridge. (AEC)

40970 GOLD PRESSURE VESSEL SEAL. A. E. Smith (to U. S. Atomic Energy Commission). U. S. Patent 3,112,115. Nov. 26, 1963.

An improved seal between the piston and die member of a piston-cylinder type pressure vessel is presented. A layer of gold, of sufficient thickness to provide an interference fit between the piston and die member, is plated on the contacting surface of at least one of the members. (AEC)

Heat Transfer and Fluid Flow

40971 (ANL-6755) TWO-COMPONENT TWO-PHASE FLOW PARAMETERS FOR LOW CIRCULATION RATES. Georges E. Smissaert (Argonne National Lab., Ill. and Associated Midwest Universities, Lemont, Ill.). July 1963. Contract W-31-109-eng-38. 68p.

Two-phase flow parameters for upward cocurrent vertical flow were studied in air–water, nitrogen–Freon-113, and nitrogen–mercury mixtures. Tests were performed in natural-circulation loops at atmospheric pressure. The superficial liquid velocity ranged from 0 to 1 ft/sec; quality ranges were as follows: for air–water, 0.0125 to 0.100; for nitrogen–Freon-113, 0.002 to 0.006; for nitrogen–mercury, 0.00005 to 0.0024. The studies of air–water and nitrogen–Freon-113 mixtures were made in 2.75-in.-ID test section; the nitrogen–mercury study was made in a 2-in.-ID pipe. The two-phase flow parameters were found to change significantly with superficial liquid velocity and quality in this low-circulation range. Slip ratios were found to be directly proportional to the surface tension of the liquid, and inversely proportional to the dynamic viscosity of the liquid. Dimensional analysis was used to correlate slip ratios and gas-to-liquid holdups as a function of four dimensionless groups which included the liquid circulation rate, the gas circulation rate, the surface tension of the liquid, the dynamic viscosity of the liquid, the density of the liquid, the density of the gas, the pipe diameter, and the acceleration due to gravity. Empirical relations were developed to evaluate slip ratios and void fractions as a function of the above-listed parameters. Flow-pattern effects were found to be conveniently described by means of a variable exponent of the Froude number. This exponent was observed to be a linearly decreasing function of the logarithm of the ratio of the volumetric flow rates. (auth)

40972 (BNL-7319) A PROPOSED MECHANISM AND METHOD OF CORRELATION FOR CONVECTIVE BOILING HEAT TRANSFER WITH LIQUID METALS. John C. Chen (Brookhaven National Lab., Upton, N. Y.). Aug. 1963. Contract AT(30-2)-Gen-16. 17p. (CONF-274-1)

From 3rd Annual High Temperature Liquid Metal Heat Transfer Technology Conference, Oak Ridge, Tenn., Sept. 1963.

An additive, interacting mechanism of micro and macro-convective heat transfer is proposed to represent boiling heat transfer with net vapor generation to saturated liquid metals in convective flow. Based on this mechanism, a method for calculating boiling coefficients is developed. The correlating is shown to be in fair agreement with early experimental results for convective boiling of potassium and sodium. (auth)

40973 (CEA-2268) ETUDE DU COMPORTEMENT DYNAMIQUE DES ECHANGEURS DE CHALEUR. (The Dynamic Behavior of Heat Exchangers). J. Fonteray and M. Rozenholc (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 45p.

In order to study the dynamics of nuclear power plants, one needs mathematical models made up of ordinary differential equations. This report deals with models for

heat exchangers. These models allow exact evaluations of the temperatures for any steady state. The deformation of the temperature maps during transients is taken into account. To do this, average temperatures are evaluated keeping in mind, on one hand, the partial differential equations, and on the other hand, the physical phenomena that are involved. Seven ordinary differential equations at most are necessary for one heat exchanger. These models were compared with mathematically exact ones and also with experimental results. The results appear to be correct. (auth)

40974 (CUA-NE-27) SIMULATED NUCLEAR REACTOR VIBRATIONAL HEAT TRANSFER. Quarterly Progress Report, November 1, 1962–January 31, 1963. (Catholic Univ. of America, Washington, D. C.). Contract AT(30-1)-2655. 53p.

Progress on the design and construction of vibrational heat transfer test sections is reported. Calibration of the ultrasonic probes to be used for the determination of the sound pressure level is summarized. Methods of reducing waves are investigated, and a number of techniques are tried in the water tank. Sound field surveys showed that the standing waves are reduced to peaks of less than 10%. A mock-up of the heater to be used in the pressurized water testing is described. Vibration studies of the heater are discussed. (N.W.R.)

40975 (HW-SA-3183) THE TURBULENT TRANSPORT AND DEPOSITION OF PARTICLES WITHIN VERTICAL TUBES. G. A. Sehmel and L. C. Schwendiman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 18, 1963. Contract AT(45-1)-1350. 16p. (CONF-255-5)

From 8th Air Cleaning Seminar, Oak Ridge, Tenn., Oct. 1963.

Theories are reviewed which predict particle deposition under turbulent flow conditions in vertical tubes. Theoretical predictions are compared with experimental deposition in 58-foot lengths of $1\frac{1}{4}$- and 3-inch-diameter tubing. Theories prove useful in predicting deposition; however, reentrainment must be considered as a separate factor when higher depositions are predicted. For 3-inch tubes, deposition at low reduced stopping distances is higher than predicted. A possible explanation is that for these conditions a transition exists to a deposition mechanism not described by the postulated theory. (auth)

40976 (NP-13186) NUMERICAL APPROXIMATIONS IN HEAT TRANSFER PROBLEMS AND USAGE OF IBM 7090 COMPUTER FOR SOLUTIONS. David W. Fox, Harry Shaw, Jr., and John Jellinek (Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.). May 17, 1962. Contract NOrd 7386. 51p.

A thermal model is used to obtain numerical approximations to the solutions of certain heat transfer problems. The thermal model consists of a lumped parameter network of thermal capacitances and conductances, and is specified via a simple FORTRAN control program. The solutions take the form of a time history of temperature distribution, and the problems concern heated structures or components of general geometry. The printout format is discussed, and a typical example is carried through in detail. Aerodynamic heating is also considered. (D.L.C.)

40977 (NYO-10432) A POWER SERIES SOLUTION FOR COMPRESSIBLE FLOW PAST A CONICAL SHOCK WAVE. Jay A. Leavitt (New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center). July 13, 1963. Contract AT(30-1)-1480. 36p.

A power series technique suggested by the Cauchy-Kowaleswaski theory and developed by Lewis and Richtmyer is applied to the conical flow problem. The numerical procedures involve algorithms that direct computation of the power series, techniques of significance arithmetic, and methods of analytic continuation. (auth)

40978 (SC-DC-3445) TEMPERATURE DISTRIBUTION AND THERMAL STRESSES IN RADIATION-COOLED CIRCULAR CYLINDERS. Technical Report ME-7. Maurice W. Wildin and William E. Putman, Jr. (Sandia Corp., Albuquerque, N. Mex.). Aug. 13, 1963. Contract AT(29-1)-789. 76p.

An investigation was undertaken to study the thermal stresses in a cylindrical NAP fuel rod. The study consisted of two phases, one analytical and the other experimental. In the analytical phase, a mathematical model of a fuel rod was developed in which the rod is considered to be a long solid circular cylinder cooled by emission of thermal radiation. A closed form of solution for the temperature distribution could not be obtained, so numerical results for the temperature and stress distributions were obtained by finite difference methods. The results predict that relatively small stresses are produced when the fuel rod is cooled in a temperature range in which brittle fracture can reasonably be expected. The experimental phase, which is not yet complete, was undertaken to verify the predicted temperature and stress distributions. Rather than using an actual fuel rod in the experimental program, which would present formidable safety and security problems, a modeling technique is being used. The theory of similitude will be employed to relate the results obtained from the physical model to those which one would expect to obtain from a fuel rod. An embedded strain gage technique is being used to measure internal strains. (auth)

40979 (TID-18193) A MODEL FOR TRANSIENT FILM BOILING. R. M. Singer (Argonne National Lab., Ill.). Dec. 1962. Contract W-31-109-Eng-38. 6p. (UAC-7144)

An analysis of transient boiling is made using Bromley's model for stable film boiling. The equations are put into dimensionless form, and the vapor film thickness, time required to reach the steady state, and vapor film growth are calculated. It is shown that the model predicts extremely short transient periods compared with these for the transient film condensation problem. (D.L.C.)

40980 (AERE-Trans-957) THEORETICAL MODEL OF THE MECHANISM OF TURBULENT EXCHANGE IN FLUID FLOWS. N. I. Buleev. Translated by J. J. Cornish (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.), from Teploperedacha, Akad. Nauk SSSR, [Energ. Inst.], 64-98(1962). 40p.

The turbulent exchange model makes it possible to formulate mathematically and to solve various problems of fluid dynamics and thermophysics for fluid flows in pipes with arbitrary cross section. The additional shearing stresses and heat fluxes in the Reynolds equations induced by turbulent fluctuations are represented by certain integrals depending on functions defined by the velocity field and on the position of the points in the domain of integration relative to the pipe wall. Calculation of the velocity field in a straight pipe with arbitrary cross section is reduced to the solution of a nonlinear two-dimensional diffusion equation. Calculation of the temperature field in the same pipe for this velocity field is reduced to the solution of a linear two-dimensional diffusion equation. The equations for velocity and temperature are solved by finite difference methods. (auth)

40981 CALCULATION OF A FLOW-RATE REGULATOR POSSESSING A LONG SLOT IN THE FLOW REGION. R. R. Ionaitis. At. Energ. (USSR), 15: 166-7(Aug. 1963). (In Russian)

The flow rate of a liquid may be changed by throttling it or by changing the operation of the pump; the first method is currently preferred in nuclear engineering. Previously used methods relied on local resistance for chocking off the flow; the method involving friction losses was not previously investigated, although it offers advantages to the reactor designer. For this reason, such a component was designed and built; its profile satisfied the following flow conditions: $Q = Q(x)$, $P = P(x)$ where Q is the flow rate of the liquid and P the pressure drop. Equations were derived for correlating the liquid density, the coefficient of hydraulic resistance, the shape of the slot's cross section, and the energy loss coefficient. Using smooth piping and staying within the Reynolds-number range from 4000 to 100,000 the dimensions of slot-type flow regulators were calculated on the basis of the obtained correlation between the factors. The method was found useful for analyzing proposed design solutions of flow regulators without actually building the component. (TTT)

40982 VELOCITY PROFILE DEVELOPMENT IN THE ENTRANCE REGION OF A RIGHT CIRCULAR CYLINDER WITH SLIP AT THE WALLS. Richard W. Hanks (Oak Ridge Gaseous Diffusion Plant, Tenn.). Phys. Fluids, 6: 1645-8(Nov. 1963). (TID-18037)

The equations of continuity and motion are solved for the velocity and pressure fields in the inlet region of a straight right circular cylinder for the flow of a gas at intermediate pressure levels such that it slips at the tube walls. Curves are presented showing the effects of distance from the inlet face of the tube, Reynolds number, and pressure level on the excess pressure drop and the velocity profiles. A table containing the first fifteen eigenvalues of the velocity equations for several pressure levels is presented. (auth)

40983 LAMINAR ENTRY PROBLEM IN POROUS TUBES. Robert W. Hornbeck, Wilfred T. Rouleau, and Fletcher Osterle (Carnegie Inst. of Tech., Pittsburgh). Phys. Fluids, 6: 1649-54(Nov. 1963).

The inlet region for laminar flow in porous pipes with small injection or suction is analyzed numerically. Finite difference methods are developed and solutions obtained for the equations of fluid motion with two different wall boundary conditions: constant injection or suction velocity through the wall, and velocity through the wall proportional to local pressure. Solutions are found for both uniform and parabolic axial velocity profiles at the pipe inlet. The results are found to be in good agreement with the solution of Weissberg for the conditions of constant suction velocity and a parabolic inlet velocity profile. Hydrodynamic entrance lengths are found and are compared for uniform and parabolic inlet profiles in the presence of constant injection or suction. (auth)

40984 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS. Andre Huet. British Patent 939,726. Oct. 16, 1963. Priority date Jan. 2, 1959, France.

A heat exchanger to be used with a heating fluid that is at high temperature and pressure is described. It consists of essentially a housing surrounding the steam-generating means. It includes elongated housing, a heating fluid inlet duct at one end of the housing, and a sleeve lining with one end surrounding and sealed to the inlet duct. (M.C.G.)

40985 IMPROVEMENTS RELATING TO TUBULAR HEAT EXCHANGERS, ESPECIALLY FOR NUCLEAR REACTOR INSTALLATIONS. (to Societe Francaise des Constructions Babcock and Wilcox). French Patent 1,290,952. Mar. 12, 1962. Filed Mar. 8, 1961.

A heat exchanger of the "monobloc" type especially for nuclear reactor installations comprises within a vertical cylindrical casing at least one series of tubes wound around an axial deflector core, while hot gas coming from the reactor flows downwards through the casing in heat exchanging relationship with the tubes. Each of the tubes has a helicoidal shape lying on one of a series of concentric director cylinders with different diameters, such as the tubes of the same series lying on the same cylinder. The tubes are provided with helicoidal cooling fins having a height and mutual distance of about the same dimension as the thickness of the tube wall. The smooth extremities of the tubes of the same series are respectively connected with upper and lower header tubes. Preferably each tube series is divided into two sub-series. The upper ends of the tubes of the lower sub-series lying on a cylinder of larger diameter are connected with the lower ends of the tubes of the upper sub-series lying on a smaller cylinder, and vice-versa. The disposition of the series is such as to get an orientation of the cooling fins parallel to the essential gas flow direction. (IIB)

40986 NOVEL FLOW DEVICE. R. E. Brockwell (to U. S. Atomic Energy Commission). U. S. Patent 3,111,963. Nov. 26, 1963.

The design of hollow, porous-walled articles is presented. By this invention a hollow, porous-walled article is made by stacking thin, centrally apertured plates having grooves extending from their central aperture to their periphery. (AEC)

Materials Testing

40987 (UCRL-7173) MODULUS OF ELASTICITY EQUIPMENT FOR HOT CELL APPLICATION. Robert E. Womack (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 10, 1963. Contract W-7405-eng-48. 12p.

Equipment has been developed for in-cell determination of the modulus of elasticity of materials by the resonance method. Size, cost, and ease of replacement are favorable factors. The accuracy of this unit has been checked against that of similar equipment at the National Bureau of Standards with excellent agreement. (auth)

GEOLOGY, MINERALOGY, AND METEOROLOGY

40988 (AFCRL-62-1092) CHLORINE 36 AND ARGON 39 IN METEORITES AND THE EXPOSURE AND TERRESTRIAL AGES OF IRON METEORITES. E. Vilcsek and H. Waenke (Max-Planck-Institut für Chemie, Mainz). 1962. Contract AF61(052)-334. 43p. (AD-292913)

About 30 meteorites were analyzed. The decay rates of chlorine-36 varied between 0 and 28 dpm/kg; for argon-39, between 0 and 23 dpm/kg. Together with the argon-36 content, cosmic ray exposure ages were calculated for the meteorites analyzed. As already previously suspected, all the octahedrites, and mainly the medium octahedrites, show exposure ages of about 500 million years. Very large differences in the cosmic ray exposure ages were observed for the group of the hexahedrites. Problems about the orbits of the hexahedrites are discussed and special boundaries for their orbits were deduced from the measurements. It could be shown that the mean cosmic ray intensity during the last 300 years was the same as during the last 300,000 years. Argon-39 was looked for in 21 different iron meteorites which were finds, and all of them, except Keen Mountain, showed no argon-39 activity. Lower limits for the terrestrial age between 1000 to 2000 years were calculated for these finds. For Keen Mountain meteorite the terrestrial age came out as about 1300 years. One meteorite, namely Tamarugal, showed also no chlorine-36 activity, indicating a terrestrial age of more than 1.5 million years. For Clark County meteorite, a terrestrial age of 600,000 years was calculated. (auth)

40989 (BNL-5555) POTASSIUM–ARGON DATING OF THE LATE TERTIARY VOLCANICS AND MINERALIZATION OF MARYSVALE, UTAH. W. A. Bassett (Brookhaven National Lab., Upton, N. Y.); P. F. Kerr (Columbia Univ., New York); O. A. Schaeffer, and R. W. Stoenner (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 31p.

The Tertiary flows and intrusives of the Marysvale, Utah area yield several materials that provide reliable absolute ages by the potassium-argon method. A layered sequence of potassium-bearing mid-Tertiary flows and tuffs of the Bullion Canyon series overlies fossil-bearing Oligocene sedimentary strata of the Wasatch formation. The series is invaded by a quartz monzonite intrusive which contains biotite. A sequence of late Tertiary volcanic rocks, the Mount Belknap series, contains potassium-bearing glasses and rests upon an old erosional surface which truncates both the Bullion Canyon and the quartz monzonite intrusive. Glassy dikes cut the quartz monzonite intrusive, and diatreme structures containing glass pierce the Bullion Canyon flows. Late Tertiary veins which contain uraninite cut the quartz monzonite intrusive and spread into lenticular masses at the base of the Mount Belknap flows. The uraninite provides a source of material for uranium-lead determinations. The absolute age of the Bullion Canyon series is approximately 30 m.y. and of the quartz monzonite intrusives is approximately 25 m.y. The most reliable age for the glassy dikes and diatremes is believed to be about 20 m.y. The determinations on glassy flows of the Mount Belknap range from 14 to 20 m.y. but alteration apparently accounts for the low ages in this range and the true age for the Mount Belknap is probably about 20 m.y. Sericite from a nearby lead-zinc-silver mine gives an age of 13.5 m.y. and the uraninite dated by uranium-lead method was found to be about 13 m.y. by Donald Miller based on work done at the Lamont Geological Observatory. (auth)

40990 (TID-19555) EVALUATION OF THE Pa^{231}/Th^{230} METHOD AS A GEOCHRONOLOGICAL TOOL FOR THE STUDY OF PELAGIC SEDIMENTS. William M. Sackett (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory. Geochemistry Lab.). Oct. 1963. Contract AT(30-1)-3139. 10p.

An evaluation of the Pa^{231}/Th^{230} method is being made. Preliminary data indicate that absolute ages for various levels of pelagic sediments are obtained only in rare instances. However, accumulation rates based on the slope of the curve of the exponential change in Th^{230}/Pa^{231} ratio with depth apparently agree with radiocarbon based accumulation rates. Various assumptions of the method are being tested. Eleven samples of sea water are being processed for their protactinium and isotopic thorium composition. (auth)

40991 NUCLEAR EXPLOSIVES AND THE MINING INDUSTRY. Giancarlo Facca and Fabio Pantanetti (Comitato Nazionale per l'Energia Nucleare, Ispra, Italy). Comit. Nazl. Energia Nucl., Notiziario, 9: Nos. 8-9, 59-60(Aug.-Sept. 1963). (In Italian)

The possibility of using nuclear energy in the mining industry has been suggested. The ideas proposed and the tests made (the Rainier and Gnome events) are briefly reviewed. The principal data obtained from these tests indicating the utility of nuclear explosions in the mining industry are summarized. (J.S.R.)

40992 SOME STUDIES ON THE APTITUDE OF CERTAIN NEOFORMATIVE CRYSTALS TO CAPTURE RADIOGENIC ARGON. Friedrich Leutwein and Grégoire Kaplan (Centre National de la Recherche Scientifique, Nancy). Compt. Rend., 257: 1315-17(Aug. 5, 1963). (In French)

Since K minerals are able to lose their radiogenic Ar in the process of metamorphosis, a study is made of the traps that capture this Ar. It is shown that the minerals of essentially pegmatitic and pneumatolytic origin are able to incorporate this Ar in microscopic inclusions and crystalline vacancies. (tr-auth)

40993 MEASUREMENT OF THE SETTLING RATE OF UNDERGROUND STRATA AT NIGATA CITY. Shunichi Sano. Genshiryoku Kogyo, 9: No. 7, 12-16(July 1963). (In Japanese)

The shrinking rate of the underground strata at Nigata City was measured by a method involving the use of a radioactive depth marker. The bullet-shaped markers containing metallic Co^{60}, shielded by a steel capsule, were driven into the ground at various depth up to 900 m. The location of the markers was determined by means of a γ-ray detector, sliding up and down through the vertical observation well. Any shift in the position of a marker could be revealed by referring to the reference Co^{60} sources, fixed to the wall of the observation well, with an accuracy of 7.5 mm. Observations carried out during the 1960 to 1961 period indicated that most of the settling occurred in the deepest strata; however, more recent measurements show that shrinkage takes place also in the shallow layers. (TTT)

40994 DETERMINATION OF THE ABSOLUTE AGE ACCORDING TO C^{14}. COMMUNICATION 4. A. P. Vinogradov, A. L. Devirts, E. I. Dobkina, and N. G.

Markova (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 9, 795-812 (Sept. 1963). (In Russian)

Results of absolute age determination of late-quaternary deposits are given. The chief material was selected from the Central region of the European territory of the USSR, it is connected with the history of the last glaciation on the surface of the Russian plain. Dating by layers of the peat deposit key sections was continued for the purpose of establishing the absolute geochronology of the Holocene. For the first time in the Soviet Union determinations were carried out on the absolute age of fossil soils from loess deposits of periglacial regions. The age of bottom sediments of the Black Sea was determined and the time was fixed at which the waters of the Mediterranean penetrated into the Black Sea. The age of found fossil animals was also determined by the radiocarbon method. A coincidence of the recent standard with the international standard (oxalic acid) was obtained. (P.C.H.)

40995 THE Rb–Sr AGE OF THE ANCIENT ROCKS OF SOUTH KARELIS. M. L. Yashchenko, I. M. Gorokhov, and S. B. Lobach-Zhuchenko (Lab. of the Geology of the Precambrian, Leningrad). Geokhimiya, No. 9, 813-19(Sept. 1963). (In Russian)

The age of granitoids of the Sunsk complex of South Karelia (2690 million years) was determined by the method of Rb–Sr-isochrone construction according to results of an analysis of 6 samples of whole rock. (auth)

40996 GAMMA-RAY SPECTROSCOPY IN WELL LOGGING. Richard L. Caldwell, Willett F. Baldwin, James D. Bargainer, James E. Berry, George N. Salaita, and Raymond W. Sloan (Socony Mobil Oil Co., Inc., Dallas). Geophysics, 28: 617-32(Aug. 1963).

Thermal neutron capture γ rays have been observed in boreholes drilled in shales, sandstones, and limestones. A capsuled source of neutrons and a scintillation crystal detector, connected through 5,000 ft of logging cable to a transistorized, multichannel, pulse-height analyzer, were used. Resolved peaks were identified on the basis of the known energies of expected γ rays and results obtained in models where conditions of porosity, casing, and fluid were controlled. To properly interpret borehole spectral data a system with good energy resolution and an accurate means of energy calibration are necessary. This is accomplished by using H and Fe to give prominent γ-ray peaks at opposite ends of the energy range of interest. On field spectra, identification was made of γ rays from Cl, Si, Ca, H, and Fe. On the basis of Cl γ rays, salt water can be differentiated from oil or fresh water. Gamma rays from Fe casing are an undesirable background and reduce the sensitivity of the method compared to that possible in an uncased hole. Two examples of natural γ-ray spectra show well resolved lines from U–Ra and Th. (auth)

40997 APPLICATIONS OF GEOLOGY TO UNDERGROUND NUCLEAR EXPLOSIONS. Nicholas M. Short (Univ. of California, Livermore). GeoTimes J., 6: No. 3, 18-23; 42-3(Oct. 1961). (UCRL-6330)

Some programs in underground nuclear explosions are summarized insofar as they relate to the geographical sciences. It is shown that geological studies provide a more realistic picture of the environment around the explosion site and detailed refinements of the generalized picture of deformation and medium response. Various specific applications of geology to individual projects are discussed under the following topics: regional mapping; geology and properties of different media; ground-water studies; rock mechanics; techniques of in situ physical property measurements; indirect applications in seismology, mining, and cratering; and special studies of high-energy explosions, phase transformations by shock waves, Hawaiian volcanoes, useful chemical reactions, differential thermal analysis, and thermoluminescence. (M.C.G.)

40998 LABELING LAKE WATER WITH TRITIUM. B. J. Frederick (U. S. Geological Survey, Oak Ridge, Tenn.). Intern. J. Appl. Radiation Isotopes, 14: 401-4(Sept. 1963). (In English)

A method of packaging tritiated water in a manner that facilitates safe handling in environmental labeling operations, and procedures followed in labeling a large body of water with a small volume of tritiated water are described. (auth)

40999 METHODS FOR SOLVING PROBLEMS OF MULTIDIMENSIONAL, PARTIALLY SATURATED STEADY FLOW IN SOILS. A. E. Reisenauer (Hanford Labs., Richland, Wash.). J. Geophys. Res., 68: 5725-33(Oct. 15, 1963).

A computer program for solving steady-state Darcian transport of fluid in heterogeneous, partially saturated, porous mediums is described. The program is capable of handling one, two, and three-dimensional and axisymmetrical problems with up to 8000 grid points. Instability of the equations and its control are discussed. Solutions of typical problems that are important in industrial waste disposal, irrigation, and drainage are presented. (auth)

41000 STRUCTURE OF THE CRUST AND UPPER MANTLE IN THE WESTERN UNITED STATES. L. C. Pakiser (Geological Survey, Denver). J. Geophys. Res., 68: 5747-56(Oct. 15, 1963).

Seismic waves generated by underground nuclear and chemical explosions were recorded in a network of nearly 2000 stations in the western United States as a part of the Vela Uniform program. The velocity of P waves in the upper mantle ranges from 7.7 km/sec in the southern part of the Basin and Range province to 8.2 km/sec in the Great Plains province, and, in general, the velocity tends to be nearly the same over large areas within individual geologic provinces. Measured crustal thickness ranges from less than 20 km in the Central Valley of California to 50 km in the Great Plains province. Changes in crustal thickness across provincial boundaries are not controlled by regional altitude above sea level unless the properties of the upper mantle are the same across those boundaries. The thickness of the crust tends to be large or small as the P wave velocity (and presumably the density) in the upper mantle is large or small. Within the Basin and Range province, the thickness of the crust seems to vary directly with regional altitude above sea level. Evidence that rocks of intermediate P wave velocity exist in the lower part of the crust was accumulated from seismic waves that have traveled least-time paths, as well as from secondary arrivals (particularly reflections). On a scale that includes many geologic provinces, isostatic compensation is related largely to variations in the density of the upper-mantle rocks. Within geologic provinces or adjacent provinces, isostatic compensation may be related to variations in the thickness of crustal layers. Regions of thick crust and dense upper mantle were relatively stable in Cenozoic time. Regions of thinner crust and low-density upper mantle have a Cenozoic history of intense diastrophism and silicic volcanism. (auth)

41001 CRUSTAL STRUCTURE IN NEVADA AND SOUTHERN IDAHO FROM NUCLEAR EXPLOSIONS. L. C.

Pakiser and D. P. Hill (Geological Survey, Denver). J. Geophys. Res., 68: 5757-66(Oct. 15, 1963).

The time of first arrival of seismic waves generated by four underground nuclear explosions at the Nevada test site and recorded along a line extending north into southern Idaho is expressed as $T_0 = 0.00 + \Delta/3.0$ (assumed), $T_1 = 0.40 + \Delta/6.03$, and $T_2 = 6.15 + \Delta/7.84$, where time is in seconds and the shot-detector distance (Δ) is in kilometers. Constant velocities and horizontal layers were assumed, and the crustal thickness in the vicinity of NTS was found to be 28 km. Delays in the travel-time segment T_2, which represents P_n, indicate that the crust may thicken to 32 km in northern Nevada. A third phase, expressed as $T_3 = 14.48 + \Delta/7.84$, was also recognized. It has arrival times appropriate for SPS. Amplitudes of P_n were determined at seven places from recordings of seismic waves from one underground nuclear explosion. (auth)

41002 CRUSTAL STRUCTURE IN EASTERN COLORADO FROM SEISMIC-REFRACTION MEASUREMENTS. W. H. Jackson, S. W. Stewart, and L. C. Pakiser (Geological Survey, Denver). J. Geophys. Res., 68: 5767-76(Oct. 15, 1963).

Seismic-refraction measurements were made at 117 spreads along a line trending north from a shot point near Lamar, Colorado, to near Sidney, Nebraska, between April and August 1961. Crustal thickness from computation based on first and prominent secondary arrivals is about 48 km. The speed of compressional waves in the upper layers of the crust ranges from 2.9 (near surface) to 6.1 km/sec. Evidence was found for a crustal layer of compressional-wave velocity 6.7 km/sec at a depth of about 28 km. The velocity of compressional waves in the upper-mantle rocks is about 8.0 km/sec. (auth)

41003 CRUSTAL STRUCTURE ALONG THE COAST OF CALIFORNIA FROM SEISMIC-REFRACTION MEASUREMENTS. J. H. Healy (Geological Survey, Denver). J. Geophys. Res., 68: 5777-87(Oct. 15, 1963).

Two reversed seismic-refraction profiles were recorded between Los Angeles and San Francisco in 1961. The three shot points were located in Santa Monica Bay near Los Angeles, offshore near San Francisco, and at Camp Roberts, about halfway between Los Angeles and San Francisco. The velocity of P_g along these profiles is 6.1 ± 0.1 km/sec with possible exceptions near San Francisco and near Los Angeles, where the scatter in the arrival times indicates complex near-surface velocity variations. The velocity of P_n between Los Angeles and Camp Roberts is 8.2 ± 0.1 km/sec, and between Camp Roberts and San Francisco it is 8.0 ± 0.2 km/sec. There is no indication of an intermediate crustal layer in the travel times of first arrivals. Computed depths to the M discontinuity, if the crust consists of a single layer, are 35 km at Los Angeles, 23 km at Camp Roberts, and 23 km at San Francisco. Refractions from crustal layers of intermediate velocity need not appear as first arrivals, and, in the extreme, the depth to the M discontinuity may be one-third greater than the thickness of a one-layer crust. Amplitude measurements on seismograms from the drilled-hole shot point at Camp Roberts give the attenuation with distance for P_g as $r^{-2.13}$. The combined data for P_g from the two shot points in the ocean give the attenuation with distance as $r^{-1.74}$. The scatter in the measured amplitudes of P_n is too large to determine a rate of attenuation with distance, but the data indicate that attenuation in the 150 to 300-km range is less than r^{-3}. (auth)

41004 CRUSTAL STRUCTURE FROM SAN FRANCISCO, CALIFORNIA, TO EUREKA, NEVADA, FROM SEISMIC-REFRACTION MEASUREMENTS. Jerry P. Eaton (Geological Survey, Denver). J. Geophys. Res., 68: 5789-5806 (Oct. 15, 1963). (TID-18946)

Seismic-refraction measurements from chemical explosions near San Francisco, California, and Fallon and Eureka, Nevada, were made along a line extending nearly 700 km inland from San Francisco across the Coast Ranges, Great Valley, Sierra Nevada, and Basin and Range province. The velocity of P_g in the Basin and Range province was found to be 6.0 km/sec. Between Fallon and Eureka the velocity of P_n is 7.8 km/sec, and just east of the Sierra Nevada it is about 7.9 km/sec. Two prominent phases closely following the first arrival between 50 and 250 km from the source in the Basin and Range province were interpreted as reflections from an intermediate layer and from the M discontinuity. The velocity of P in the possible intermediate layer, deduced from the reflected phases because the refracted wave expected from this layer is nowhere a first arrival, seems to be 6.6 km/sec at the top of the layer and probably increases with depth. In the Coast Range northeast of San Francisco, the velocity of P in the crust, 5.4 to 5.6 km/sec, is substantially smaller than in the Basin and Range province. When corrected for abnormal delays in the sediments, first arrivals from San Francisco across the Great Valley suggest a P_n velocity of 7.9 km/sec. The low apparent velocity of first arrivals on this profile beyond the valley indicates that the M discontinuity dips downward beneath the Sierra Nevada. From a depth of about 20 km beneath the Coast Ranges and Great Valley, the M discontinuity descends to at least 40 km beneath the high Sierra Nevada. East of the Sierra Nevada it rises rapidly to about 22 km beneath Carson Sink and then dips downward toward Eureka, where it reaches a depth of 32 km. If the intermediate layer is real, the foregoing depths are increased by 2 to 5 km. (auth)

41005 GRAVITY AND CRUSTAL STRUCTURE IN THE WESTERN SNAKE RIVER PLAIN, IDAHO. D. P. Hill (Geological Survey, Denver). J. Geophys. Res., 68: 5807-19 (Oct. 15, 1963).

A gravity survey was made over the western Snake River Plain, Idaho. The data were reduced to sea level and expressed as simple Bouguer gravity anomalies for an assumed density of 2.67 g/cm^3. Three elongated, northwest-trending, en echelon gravity highs were defined by the survey. The largest high is about 150 km long and 40 km wide; its maximum amplitude is 70 mgal. Application of limiting-depth methods implies that the tops of the disturbing bodies can be no deeper than 5 km below sea level. Two-dimensional analyses, based on a density contrast of 0.3 g/cm^3, indicate that the anomaly-causing bodies extend from near sea level to at least 6 km below sea level and possibly to as much as 18 km below sea level. The total mass excess of the disturbing bodies is estimated to be 1×10^{19} g, and the corresponding volume for material 0.3 g/cm^3 more dense than the surrounding material is approximately 33,000 km^3. If the highlands on either side of the plain are regionally compensated, the crust under the plain is probably undercompensated by an amount proportional to the local anomalous bodies. (auth)

41006 TRAVEL TIMES AND AMPLITUDES FROM NUCLEAR EXPLOSIONS, NEVADA TEST SITE TO ORDWAY, COLORADO. Alan Ryall and David J. Stuart (Geological Survey, Denver). J. Geophys. Res., 68: 5821-35(Oct. 15, 1963).

The results of a study of seismic waves generated by eight nuclear explosions and recorded at 31 locations between the Nevada test site (NTS) and Ordway, Colorado,

are discussed. The line of recording stations crosses the eastern part of the Basin and Range province, the Colorado plateaus, and the southern Rocky Mountains, and it extends into the Great Plains. In the eastern Basin and Range province and the western part of the Colorado plateaus ($0 \leq \Delta \leq 385$ km), the time-distance curves for P_g and P_n can be expressed, respectively, as $T_1 = 0.8 + \Delta/6.0$ and $T_3 = 5.8 + \Delta/7.6$. A third phase, tentatively identified as P*, is represented by the equation $T_2 = 3.8 + \Delta/6.5$. Using the crustal structure and P_n velocity (7.9 km/sec) found for the NTS region by others, it is found that the above relations indicate that the thickness of the crust increases from about 25 km at NTS to about 42 km in the western part of the Colorado plateaus. East of this boundary the velocity of P in the upper mantle increases to 8.0 km/sec; depth to the M discontinuity in the Colorado plateaus is approximately constant over the range $435 \leq \Delta \leq 645$ km. Beyond 850 km, first arrivals in the southern Rocky Mountains and Great Plains provinces indicate an apparent velocity of about 8.4 km/sec. Amplitudes of P_n attenuate according to the equation $A = A_0\Delta^{-1/2}\ (\Delta - d)^{-1/2}\ e^{-0.0022\Delta}$ over the distance range $150 \leq \Delta \leq 850$ km ($d = 60$ km). This relation yields a value of Q, for P_n, of about 520. The amplitudes of P_g attenuate extremely rapidly, and beyond about 130 km this phase cannot be identified with certainty. An extension of the P_g travel-time branch at long distances could be associated with waves reflected beyond the critical angle, from the base of the crust. This phase, called $\overline{P}$ after Mohorovičić, appears to attenuate as $A = A_0\ e^{-0.0078\Delta}\Delta^{-1/2}$. The value of Q indicated by this equation is about 200. (auth)

41007 SEISMIC-REFRACTION MEASUREMENTS OF CRUSTAL STRUCTURE BETWEEN SANTA MONICA BAY AND LAKE MEAD. John C. Roller and John H. Healy (Geological Survey, Denver). J. Geophys. Res., 68: 5837-49(Oct. 15, 1963).

A reversed seismic-refraction profile was recorded between Santa Monica Bay, California, and Lake Mead, Nevada, during November 1961. Depth to the M discontinuity was determined to be approximately 29 km at Santa Monica Bay, 36 km under the Transverse Ranges, 26 km under the Mojave Desert, and 30 km at Lake Mead. Prominent events on the seismograms in the distance range 30 to 150 km are interpreted as reflections from the M discontinuity and from a crustal layer of intermediate velocity. These reflected events are used to make a detailed interpretation of crustal structure. The velocity of compressional waves in the mantle immediately below the M discontinuity was determined to be 7.8 km/sec. The velocity of compressional waves in the intermediate layer is near 7.0 km/sec. The apparent velocity of the direct arrival in the crustal rocks near the surface is 6.3 km/sec northeast of Santa Monica Bay and 6.1 km/sec southwest of Lake Mead. The higher apparent velocity for the direct arrival from Santa Monica Bay seems to be the result of thinning toward the east of low-velocity rocks near the surface. These low-velocity near-surface rocks are Cenozoic sedimentary rocks and fractured and weathered granitic and metamorphic rocks. The velocity of S_g was determined to be 3.4 km/sec near Lake Mead. A prominent phase of apparent velocity 6.3 to 6.4 km/sec was recorded at distances beyond 200 km. This phase is identified as $\overline{P}$ and is interpreted as a reflection from the intermediate layer. Amplitude measurements support the conclusion that the $\overline{P}$ phase is a reflected arrival. (auth)

41008 FISSION PRODUCTS IN ANTARCTIC SNOW, A REFERENCE LEVEL FOR MEASURING ACCUMULATION. E. Picciotto and S. Wilgain (Université Libre, Brussels). J. Geophys. Res., 68: 5965-72(Nov. 1, 1963).

In the area around King Baudouin Station (70°S, 24°E), it is shown that a reference horizon, easy to identify, was formed by the stratospheric fallout of radioactive debris from thermonuclear bomb tests. Gross β activity and Sr^{90} were measured in snow and firn samples from 1935 to 1960. The samples were dated by stratigraphy and by oxygen isotope-ratio measurements. The contribution of natural radionuclides is negligible, and the gross β activity can be taken as a measure of the fission products concentration. The following average values were found: from 1955 to 1960, 14 dpm/kg of snow; beginning of 1955, 22 dpm/kg ($Sr^{90} = 4.5$); 1953 and 1954, 2 dpm/kg; and from 1935 to 1952: 0.5 dpm/kg ($Sr^{90} < 0.1$). The sharp tenfold increase in the β activity at the beginning of 1955 is attributed to the sudden release in the antarctic troposphere of fission products from the Castle thermonuclear tests series (March 1954). The previous and first thermonuclear test (Ivy, November 1952) is less marked. The β activity before 1952 is essentially due to Pb^{210} and K^{40}. There are indications that this radioactive horizon was formed at the same time over the whole ice cap, but direct checks are needed on more, well-dated firn profiles. (auth)

41009 COSMIC RAY PRODUCED RADIONUCLIDES IN THE SEA. D. Lal (Tata Inst. of Fundamental Research, Bombay). J. Oceanog. Soc. Japan, [20]: 600-14(1962).

The connection between cosmic rays and the various earth sciences has grown rapidly during the last few years. The close link which exists between these fields is a consequence of the production of radioisotopes in the atmosphere by cosmic-ray particles, and the possibility of using them as tracers. Applications of these tracers to the study of marine phenomena are discussed. Several isotopes, which have the necessary chemical and physical properties to function as suitable tracers for studying either large scale circulation and mixing of water within and between the oceans or the rates of settling of sediments on the ocean floor, have already been detected. With further improvement in the techniques of measurement, few more useful isotopes can be detected. These isotopes have already begun to make useful contributions to the understanding of marine phenomena. The present state of knowledge based on the study of cosmic-ray-produced isotopes in marine environments is discussed. It is shown that the results to date are only an indication of the vast potentialities inherent in the use of these tracers for the study of diverse oceanographic phenomena. (auth)

41010 SURFACE-BARRIER DETECTORS MAKE ISOTOPIC AGE MEASUREMENTS. W. L. Weiss and E. M. Whatley (Oak Ridge Technical Enterprises Corp., Tenn.). Nucleonics, 21: No. 9, 66(Sept. 1963).

Surface-barrier detectors can reduce the complexity and increase the accuracy of low-level measurements used in geologic age determination. These detectors have the advantage over conventional detectors of better resolution (0.5% compared with 3%) and a smaller background level for alpha counting (0.008 cpm compared with 1 to 2 cpm). (R.E.U.)

41011 RESULTS OBTAINED WITH LIGHT-WEIGHT RATE METER FOR NEUTRON SOIL-MOISTURE MEASUREMENTS. Frank E. Robinson (Experiment Station of the Hawaiian Sugar Planters Assoc., Honolulu). Soil Sci., 96: 218-19(Sept. 1963).

The light-weight rate meter described by Van Bavel was used with a 2 mC source in a Troxler 104 probe to meas-

ure neutron soil-moisture. Precision of 2 cps, equivalent to 1.00 per cent moisture or less, was obtained in Hawaiian soils in a moisture range of 10 to 40 per cent by volume. Utilizing the 1620 IBM computer and a multiple correlation analysis program, the calibration curve was defined. Soil pits were opened to the access tubing, and 3-in. cores were removed in duplicate. The slopes were 0.0101 for Puunene silty clay, 0.0106 for Paia silty day, 0.0117 for Catano sand, 0.0117 for Keahua silty clay, and 0.0133 for Maliko silty clay. It was concluded that the neutron moisture meter described by Van Bavel can be used to measure moisture in Hawaiian soils with a precision of ±1 per cent. (H.M.G.)

41012 GEOLOGIYA MESTOROZHDENII REDKIKH ELEMENTOV. VYPUSK 14. TIPY MESTOROZHDENII REDKIKH ELEMENTOV I IKH POISKOVYE KRITERII. (Geology of Rare Earth Deposits. Issue No. 14. Types of Rare Earth Deposits and Exploratory Criterion for Them). Moscow, Publishing House of Scientific-Geological Literature on Geology and Protection of Natural Resources, 1961. 148p.

Specific properties of rare earths and factors conducive to rare earth deposit concentration are discussed. Various types of rare earth deposits are described, and exploration for rare metal pegmatites, pneumatolytic-hydrothermal deposits of beryllium, albites, and carbonite deposits is analyzed. 182 references are included. (R.V.J.)

41013 NUCLEAR WELL LOGGING. John T. Dewan and Charles W. Johnstone (to Schlumberger Well Surveying Corp.). U. S. Patent 3,108,188. Oct. 22, 1963. Filed Apr. 3, 1959.

An improved method for distinguishing well formations containing oil from those containing salt water in nuclear well logging is described. Borehole formations are irradiated with neutrons and the intensity of gamma rays characteristic of neutron capture by nuclei of an element present in one of the formation fluids to be distinguished but not in the other are measured. In order to eliminate effects due to variations in formation porosity, the intensity of gamma rays characteristic of capture by nuclei of another element present in both of the fluids is also measured and compared with the first measurement. (M.C.G.)

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Refer also to abstract 42397.

41014 (AED-C-13-02) AUSGEWÄHLTES SCHRIFTTUM NACH SACHGEBIETEN. DEKONTAMINATION. BIBLIOGRAPHISCHE ZUSAMMENSTELLUNG. (Selected Literature According to Subject Field. Decontamination. Bibliographic Compilation). H. Philipp, comp. (Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H., Karlsruhe, Germany). Aug. 1963. 167p.

Two hundred and twenty-two references on decontamination, covering through Dec. 31, 1961, are presented according to consecutive number and, with abstracts, according to subject. Report number, patent number, and author indexes are included. (M.C.G.)

41015 (ANL-6759) THE PLUTONIUM AEROSOL MONITORING PROGRAM AT ANL-IDAHO FACILITIES. P. G. Stoddart (Argonne National Lab., Idaho Falls, Idaho). July 1963. Contract W-31-109-eng-38. 33p.

The physical and radiation characteristics of plutonium aerosols are reviewed briefly. A number of detecting and sampling devices and techniques are discussed for application to plutonium aerosols under conditions of reactor operations. The monitoring program and the Pu-fueled reactors at ANL-Idaho are described. (D.L.C.)

41016 (CEA-2261) RESULTATS DES MESURES DE CONCENTRATION, DANS LA BASSE ATMOSPHERE, DES AEROSOLS RADIOACTIFS ARTIFICIELS. (Results of Concentration Measurements of Artificial Radioactive Aerosols in the Lower Atmosphere). B. Ardouin, C. Jehanno, J. Labeyrie, G. Lambert, O. Tanaevsky, and E. Vassy (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 138p.

Results are given of the measurements of artificial gross β radioactivity in aerosols in the lower atmosphere made by the Electronic Physics Service of the Electronic Department, and by the Atmospheric Physics Laboratory of the Paris Science Faculty. The measurements were begun in September 1956 and were continued in an increasing number of stations both in France and in the rest of the world. The reported results deal with the period up to the end of August 1961, that is, up to the end of the nuclear moratorium. After a review of the constitution and the properties of radioactive aerosols present in the atmosphere, a description is given of the measurement methods, their accuracy, and various aspects of the results. (auth)

41017 (CEA-2302) CONTRIBUTION PRATIQUE A LA DOSIMETRIE DES NEUTRONS RAPIDES EN RADIOPROTECTION. DETERMINATION DE LA DOSE INTEGREE PAR REACTION $^{32}S(n,p)^{32}P$ CHEZ L'HOMME. (A Practical Contribution to the Dosimetry of Fast Neutrons in Radioprotection — Determination of the Integrated Dose in Man Using the $S^{32}(n,p)P^{32}$ Reaction). J. Scheidhauer and M. Chabidon (France. Commissariat à l'Energie Atomique. Centre de Production de Plutonium de Marcoule, Chusclan). 1963. 16p.

The problem of fast neutron dosimetry using activation is studied from the radio-protection point of view. The practical development of methods for analyzing P^{32} produced by the activation of S^{32} in human hair by the reaction $S^{32}(n,p)P^{32}$ is described. The sensitivity obtained is 5 rad. A preliminary study was made of the variations in the natural sulfur and phosphorus concentrations. (auth)

41018 (CEX-61.6.1) ARMS II — LAS VEGAS AREA AERORADIOACTIVITY SURVEY. R. B. Guillou, J. E. Hand, and H. M. Borella (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). Oct. 6, 1961. Contract [AT(29-1)-1183]. 29p. (S-54)

An Aerial Radiological Measuring Survey (ARMS) of the Las Vegas area was made for the Civil Effects Test Operations, Division of Biology and Medicine, U. S. Atomic Energy Commission, between May 21 and June 23, 1961. The survey was part of a nationwide program to measure present environmental levels of gamma radiation. Approximately 6000 traverse miles were flown, at an altitude of 500 ft above the ground, in a 100-mile square centered near Las Vegas. The EG&G ARMS-II instrumentation was used in the survey. The data are presented in aeroradioactivity units, or areas with similar gamma radiation rates at 500 ft, at two map scales: (1) generalized at about 1:1,500,000 and (2) detailed at 1:250,000. Maximum readings in most of the north half of the area are below 400 counts/sec; in only one sizable area are they above 800 counts/sec. The south half of the area, which is much more radioactive, can be divided into three sections: (1) a west section, where the maximum count rate is usually below 800 counts/sec; (2) a center section, where the maximum count rate is less than 4000 counts/sec in half the section and less than 1200 counts/sec in the other half; and (3) a heterogeneous east section, where less than 1200 counts/sec predominates but where there are sizable higher areas. The general distribution of radioactivity can be directly attributed to the geology of the area. Carbonate and clastic rocks usually are associated with low aeroradioactivity levels; metamorphic, intrusive, and volcanic rocks generally give rise to moderate to high aeroradioactivity levels. Although artificial radionuclides may have influenced the distribution of aeroradioactivity units in a few places in the extreme northwest portion of the area, the natural plus the artificial radioactivity in the northern area was much lower than the natural radioactivity of many units in the southern section. (auth)

41019 (DP-861) USE OF VORTEX TUBE FOR COOLING WEARERS OF INDUSTRIAL PROTECTIVE CLOTHING. J. M. Alexander, J. J. Croley, Jr., and R. R. Messick (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). Oct. 1963. Contract AT(07-2)-1. 29p.

A Ranque-Hilsch vortex tube worn as a portable refrigerator can satisfactorily cool compressed air for personnel wearing industrial protective clothing. The vortex tube described was modified to meet Savannah River Plant specifications; it is light and small, and can be strapped to the body where it does not interfere with physical movements. The tube operates on 20 to 25 cfm of compressed air at 80 to 100 psig and delivers from 15 to 18 cfm of air cooled 50 to 60°F below the inlet air temperature. (auth)

41020 (HW-SA-2859) PLANNING FOR CARE OF INJURED RADIATING PATIENTS. W. D. Norwood (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Dec. 29, 1962]. Contract AT(45-1)-1350. 12p.

The possibility of the occurrence of accidents that would result in injured radioactive employees in an atomic energy installation is discussed. Emergency temporary type facilities that have been made available for handling such an

event are described. The more permanent type facility recommended for dealing with such an event is also considered. Because of the cost, much thought is required to ensure a reasonably adequate facility at justifiable cost. Plans are discussed for quickly assembling the medical and supporting team required to deal with such a catastrophe. (auth)

41021 (HW-SA-3037) A DISCUSSION OF PERSONAL PROTECTIVE EQUIPMENT FOR LIMITING INHALATION OF NOXIOUS AND IRRITATING SUBSTANCES. D. E. Wisehart (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [May 7, 1963]. Contract AT (45-1)-1350. 14p. (CONF-261-1)

From Northwest Association of Occupational Medicine Annual Meeting, Richland, Wash., May 1963.

Protective equipment for limiting the inhalation of noxious and irritating substances is discussed. The equipment is classified as devices that provide self-contained clean air to the wearer; devices that provide externally supplied clean air, with an airhose connecting the wearer to a continuous air supply; devices that purify exhaled air for reuse; and devices that purify the surrounding air prior to inhalation. Advantages of the air-purifying devices include cost, weight, mobility, and long usage times between cartridge or canister changes. The main disadvantage may be a lower degree of protection than may be obtained with other types. Design features and performance of various respirators are discussed. (C.H.)

41022 (HW-SA-3071) PHYSICAL AND CHEMICAL FORM OF I^{131} IN FALLOUT. R. W. Perkins (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Oct. 1961]. Contract AT(45-1)-1350. 18p. (CONF-66-10)

From Symposium on the Biology of Radioiodine, Richland, Wash., June 1963.

Physical and chemical form studies of fallout I^{131} following the USSR nuclear tests of late 1961 and the U. S. and USSR studies of 1962 have shown that the fraction existing in the gaseous state varied from about 10 to 90%. Very little of the gaseous I^{131} appeared to be in the elemental or HI form. The I^{131} which could easily be leached from the particulate portion of the fallout was found to be mainly in the reduced form as iodides or elemental iodine, about one third was in the iodate form and very little or none in the periodate form. (auth)

41023 (HW-SA-3161) FACTORS AFFECTING RETENTION, TRANSLOCATION, AND EXCRETION OF RADIOACTIVE PARTICLES. W. J. Bair, B. O. Stuart, J. F. Park, and W. J. Clarke (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Aug. 20, 1963]. Contract AT(45-1)-1350. 33p. (CONF-104-51)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Published data are cited demonstrating that the behavior of many inhaled radioactive aerosols cannot be predicted on the basis of their known chemical properties. For example, the uptake of I^{131} by the thyroid was equally rapid following inhalation of I^{131} vapor and the less water soluble AgI^{131} particles, and $Sr^{90}SO_4$ was absorbed from the lungs at a rate comparable to that of the more soluble $Sr^{90}Cl_2$. The pulmonary retention of soluble $CeCl_3$ and insoluble CeO_2 was similar but much greater for insoluble CeF_3. Pulmonary retention of soluble and insoluble forms of Eu^{152}, Co^{60}, U^{238}, and Pu^{239} is also compared. The results of Pu studies also illustrate the effect of a further complicating variable, particle size of the aerosol. When inhaled as an aerosol with a mass median diameter (MMD) of 0.2 μ, insoluble $Pu^{239}O_2$ was cleared from the lung at a rate comparable to that observed for the more soluble plutonium nitrate, i.e., retention half time of about 30 days. Retention half time values of >100 days were obtained when the MMD of the $Pu^{239}O_2$ aerosol was 2 to 7 μ. The rapid clearance of $Pu^{239}O_2$ inhaled as extremely small particles, substantiated by autoradiographic studies, was reflected in higher rates of excretion and translocation to other tissues. These results were applied to the problem of inhaled U ore where the chemical species and physical characteristics of the dust may determine whether U remains in secular equilibrium with its daughter products after deposition in the lung. (auth)

41024 (HW-SA-3187) SOME OBSERVATIONS OF IODINE REMOVAL FROM PLANT STREAMS WITH CHARCOAL. J. D. McCormack (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 16, 1963. Contract AT(45-1)-1350. 11p. (CONF-255-3)

From 8th Air Cleaning Seminar, Oak Ridge, Tenn., Oct. 1963.

The performance of several large scale charcoal beds in radioiodine removal service is discussed. The efficiency of the beds was measured after service times of months to years, and appears to be related to the quality of the air being treated. Efficiencies of 99.9 per cent to nearly zero per cent were noted. (auth)

41025 (NP-13147) PREDICTION OF FIRE SPREAD FOLLOWING NUCLEAR EXPLOSIONS. Craig C. Chandler, Theodore G. Storey, and Charles D. Tangren (Forest Service. Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.). 1963. Contract OCD-OS-62-131. 110p.

An exhaustive study was made to identify the parameters significant to the spread and intensity of mass fires, suggest methods of measuring and codifying these parameters, and collect specific input data to be used in testing a predictive model of fire spread. The study was confined to mass fires spreading from the area of initial ignitions following nuclear attack, and the behavior of these fires was assumed to be similar to that of "normal" large-area fires which occurred in the past. Nearly 2,000 fires were studied, 1,687 rates of spread were collected, and conditions were determined under which fires would not spread significantly and/or would be self-extinguished. (D.L.C.)

41026 (NP-13193) DATA FROM RADIATION PROTECTION PROGRAMS. Volume 1, No. 9. (Canada. Dept. of National Health and Welfare, Ottawa). Sept. 1963. 52p. (In English and French)

Data are presented on levels of fallout radioactivity in air and precipitation at various locations in Canada during July and August, 1963. The Sr^{90} content in wheat grown in 1962 was determined. Data are included on fresh milk consumption habits of Canadians. (C.H.)

41027 (NYO-9678) STRATOSPHERIC MONITORING PROGRAM SEMI-ANNUAL PROGRESS REPORT, FEBRUARY 1963–AUGUST 1963. M. Lippmann, comp. (Del. Electronics Corp., Mount Vernon, N. Y.). Sept. 18, 1963. Contract AT(30-1)-2363. 76p.

The performance of the Model I electrostatic precipitator sampler in recent field and laboratory tests is described and discussed. Two of the four precipitator-bearing balloon flights during this interval reached the floating altitude of ~105,000 feet, and the precipitator operated efficiently on both. One sample was collected at the nominal design flowrate of ~100 cfm, and the second at ~200 cfm. Comparison of the deposition profiles of the

stratospheric samples with those obtained under controlled conditions in the altitude chamber indicates that the field samples were collected with >90% efficiency. The laboratory tests also showed that the performance capability of the precipitator improves with increasing precipitator current, and with increasing altitude. One of the above balloon flights carried two Model A-I altimeters with recorder outputs. The two records were identical within ±250 feet. In addition, variations in altitude indications were consistent with the less sensitive aneroid barocoder measurements from the same flight. A revised Model A-I altimeter with a telemeterable output signal has been designed and constructed. The frequency of the signal is a function of the altitude. A preliminary design concept for a flowmeter with negligible flow resistance is described. It would utilize a velocity profile traverse, with the velocity at the various radial locations measured by ion tracers. Further design considerations for a high volume precipitator configuration are discussed. (auth)

41028 (ORNL-TM-683) NUCLEAR SAFETY PILOT PLANT HAZARDS SUMMARY REPORT. L. F. Parsley, Jr. (Oak Ridge National Lab., Tenn.). Oct. 4, 1963. Contract W-7405-eng-26. 70p.

The Nuclear Safety Pilot Plant is described. Irradiated UO_2 containing up to 1000 curies of mixed beta-gamma activity will be melted in a special furnace, and the volatile fission products will be introduced into a 1350-ft^3 model containment vessel for study of transport phenomena. At the end of an experiment the remaining volatile fission products will be purged through a filter system, and samples will be recovered by remote-handling techniques. Hazards associated with normal operation of the plant and with operating emergencies are discussed. The most serious hazard is spread of contamination in the cell and in the building as a result of the large number of contaminated samples and components which must be handled. Equipment and procedures are provided to minimize the possibility of spreading contamination. The maximum credible accident is release of all of the volatile fission products instantaneously through the stack system. The resulting ground-level concentrations do not produce radiation exposure exceeding accidental tolerance. (auth)

41029 (PNROO-DEV-125) ENVIRONMENTAL RADIOACTIVITY AT THE SHIPPINGPORT ATOMIC POWER STATION FOR THE SECOND HALF OF 1962 AND FOR CALENDAR YEAR 1962. (Pittsburgh Naval Reactors Operations Office, AEC). 9p.

During the second half of 1962, measurements of radioactivity were made in the Ohio River, atmosphere, and fallout in the vicinity of the Shippingport Atomic Power Station. The results of these measurements support the conclusion that the radioactive waste released by the power station into the air and into the Ohio River did not result in a significant change in the naturally occurring radioactivity in the environment. During the last six months of 1962 a total of 51,612 μc of liquid radioactive waste (exclusive of tritium), 0.621 curie of tritium, and 12.1 mc of xenon-133 gas were released into the environment at concentrations less than $^1/_{10}$ of the amounts recommended by the National Committee on Radiation Protection (NCRP). The average concentration of gross radioactivity in the liquid effluent was 3.0×10^{-9} $\mu c/ml$, and that for tritium was 1.2×10^{-7} $\mu c/ml$. The gaseous xenon-133 was released at an air concentration of 1.3×10^{-7} $\mu c/cc$. The Ohio River had an average concentration of gross beta radioactivity of 3.0×10^{-9} $\mu c/ml$ upstream (sampled at one location) and an average of 3.7×10^{-9} $\mu c/ml$ downstream (sampled at one location) of the liquid waste disposal outfall. The concentration of potassium-40 in the plant river water influent and effluent was 5.5×10^{-9} and $5.4\ \mu\ 10^{-9}$ $\mu c/ml$, respectively. Airborne particulate radioactivity was measured and recorded at two stations. The average air concentration at Station No. 1 was 1.0×10^{-12} $\mu c/cc$, and at Station No. 3 the average air concentration was 1.5×10^{-12} $\mu c/cc$ (Station No. 2 was out of order during report period). The maximum and minimum concentrations for both stations were 8.5×10^{-12} and 7.9×10^{-14} μc cc. The average radiation levels from Stations No. 1 and No. 3 were essentially the same, 0.020 and 0.023 mr/hr. The maximum and minimum for both stations were 0.060 and 0.008 mr/hr. Radioactive fallout samples were taken at three different locations and analyzed monthly for beta radioactivity. The average for all stations was 519 mc/mi^2/month. Measurements ranged from a low of 300 mc/mi^2/month to a high of 730 mc/mi^2/month. A table summarizes the essential environmental monitoring data for the year 1962. The data indicate that at no time did the radioactivity releases from Shippingport exceed the recommended values, and that these releases did not cause a significant increase in background levels of radioactivity. (auth)

41030 (RFP-329) MANUAL FOR THE USE OF BOROSILICATE RASCHIG RINGS AS A FIXED NUCLEAR POISON. W. E. Schunter and R. W. Woodard (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). Oct. 3, 1963. Contract AT(29-1)-1106. 13p.

This manual presents specifications for borosilicate glass Raschig rings for use in processing operations, procedures for filling vessels with rings, and procedures for inspecting rings in enriched uranium operations and plutonium operations. (D.L.C.)

41031 (SCPRI(RM)VII-1963) RAPPORT D'ACTIVITE, JUILLET 1963. (Report of Activities, July 1963). (France. Service Central de Protection contre les Rayonnements Ionisants, Paris). 20p.

The results of the radiological monitoring of the atmosphere, rain water, nuclear sites, the food chain, and sea water are briefly summarized and shown graphically and in tabular form. (J.S.R.)

41032 (TID-19492) ENVIRONMENTAL MONITORING SEMI-ANNUAL REPORT JANUARY THROUGH JUNE 1963. P. C. Adams (Mound Lab., Miamisburg, Ohio). July 15, 1963. Contract AT-33-3-GEN-53. 22p.

The concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the first half of 1963 is presented. The concentration of polonium and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during the first half of 1963. (auth)

41033 (UCRL-10255) ENVIRONMENTAL SAMPLING AT LAWRENCE RADIATION LABORATORY, BERKELEY. Herbert P. Cantelow, J. Stafford Peck, Albert E. Salo, and Patrick W. Howe (California. Univ., Berkeley. Lawrence Radiation Lab.). May 21, 1962. Contract W-7405-eng-48. 22p.

Among the more unusual features pertaining to the environmental sampling program at the Berkeley site of the Lawrence Radiation Laboratory are: (1) the difficult clima-

tological situation arising from meteorological factors in conjunction with the hilly terrain; (2) the very close proximity of densely populated areas; and (3) the wide range of the research program carried out at LRL. Efforts to overcome these difficulties are discussed and the general scope of the Environmental Sampling Program is briefly described. An air and atmospheric deposition sampling station of unique design is shown. The advantages of automatic data processing in handling and presenting the large amounts of data collected are discussed. IBM 650 and 1401 computers plus allied equipment are used for rapid and systematic data compilation. (auth)

41034 (USNRDL-TR-669) RADIONUCLIDE RELEASE FROM AERO-SPACE NUCLEAR REACTOR FUELS. I. SAFETY ANALYSIS OF PULSED NEUTRON IRRADIATION OF DRY FUEL. J. L. Mackin and P. E. Zigman (Naval Radiological Defense Lab., San Francisco). Aug. 8, 1963. Contract AT(49-5)-2084. 28p.

The safety of in-core exposures of ROVER/NERVA fuel to pulsed neutron irradiation was analyzed. Exposure in a dry environment of fuel specimens containing one gram of U^{235} to a TRIGA Mark F power transient (following a three dollar step increase in reactivity) was examined. These examinations indicate that expected temperatures, pressures, and radiation levels are well within required safety limits. (auth)

41035 SAFE WAY TO MACHINE BERYLLIUM. J. Cholak. Am. Machinist/Metalworking Manuf., 107: 82-4(May 27, 1963).

An abridged version of a comprehensive guide on the safe-working of beryllium is presented. The importance of adequate air-sampling when machining beryllium, and of the provision of suction equipment is stressed; the use of hoods to direct the air away from the machine operator is also discussed. (TCO)

41036 THE EFFECT OF I.A.E.A. REGULATIONS ON THE DESIGN OF SHIELDED CONTAINERS. F. E. Dixon (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Atom, No. 84, 315-24(Oct. 1963).

Some problems met with in designing shielded containers for radioactive materials, capable of meeting the I.A.E.A. regulations, are discussed. Various tests of durability under fire, impact, and rupture were carried out, and results are briefly summarized. (R.E.U.)

41037 RADIOACTIVE CONTROL ON ATMOSPHERIC ELECTRICAL BASIS. A. Oster. Atomkernenergie, 8: 329-34(Sept. 1963). (In German)

Theoretical investigations were made of how far survey measurements of radioactivity in the air may be carried out by methods of atmospheric electricity. For this, the influence of a radioactive cloud on the elements of atmospheric electricity in the cloud and in its surrounding was estimated. The derived formulas were applied on some examples. These show the results of obtained relationship for practical use. (auth)

41038 THE TRANSPORT OF RADIOACTIVE MATERIALS. J. Nesselmann. Atomwirtschaft, 8: 400-1(July-Aug. 1963). (In German)

The conveyance of radioactive materials by public transport services is subject to license in the German Federal Republic. The licensing is issued by the appropriate authority in the form of a general transport license extending, at the most, for three years. The licensing is combined with conditions in respect of the transport processes and in respect of cover protection to fulfill the legal obligations concerning damage compensation. The laws and regulations have, in practice, raised some problems. In particular the transport of items with radioactive content by the Deutsche Bundesbahn became uncertain according to the regulations. This difficulty was resolved by a special licensing of the Federal Transport Ministry by which substances with short half value periods could be displaced for the time being in the hitherto customary protective packing. A further problem concerns the fulfillment of the obligations concerning damage compensation in connection with the transport of radioactive materials. (auth)

41039 PROBLEMS AND PRACTICE OF THE TRANSPORT OF RADIOACTIVE MATERIALS BY RAIL. K. Werner. Atomwirtschaft, 8: 402-5(July-Aug. 1963). (In German)

International regulations concerning the transport of radioactive materials by rail are discussed. The most important changes are the regulations dealing with the prevention of criticality of nuclear fuels, new divisions of the radio-toxicity groups and of packing types and changes in respect of the white and yellow danger categories. The provisions of the Rail Regulations governing internal German traffic were altered accordingly but only to raise various impediments which have practically precluded the transport of radioactive materials as express goods. Because of this a provisional regulation was made by special licensing of the Transport Ministry for short lived radioisotopes. (auth)

41040 PROBLEMS OF THE TRANSPORT OF IRRADIATED NUCLEAR FUELS. Klaus Werner and Joachim Burghardt (AEG, Frankfurt am Main). Atomwirtschaft, 8: 405-8(July-Aug. 1963). (In German)

Two questions which are important for the operation of nuclear reactors and for the economics of nuclear power stations are discussed: how can irradiated fuels be transported to a reprocessing installation and what costs are involved in such transport? In the German Federal Republic numerous licenses have to be obtained: for export, transport, storage, intermediate storage, transport containers, etc., whose basis lies in various legal provisions. In particular the liability and insurance stipulations must be observed both at home and abroad. These place special demands on the transport technicalities (packing, handling, provision of means of transport, etc.). (auth)

41041 PERSONNEL DOSE MEASUREMENT WITH FILMS. F. Wachsmann (Universität, Erlangen-Nuremberg). Atomwirtschaft, 8: 424-6(July-Aug. 1963). (In German)

Basically two methods are available for the measurement of personnel dosage: directly readable dosemeters and dosemeters which cannot be read directly and whose indications cannot be erased. The First Radiation Protection Regulation of the German Federal Republic prescribes the simultaneous use of both types for persons working with nuclear radiations. Film dosemeters are particularly suitable for the measurement of personnel dosages, they have a wide measuring range and are reliable, simple, and cheap. In Germany, when film dosemeters were introduced for personnel dose measurements, it was decided to make use of the technique of filter analysis. This involves covering the film used for the dose measurement with several filters of various strengths; it is then possible to determine the radiation quality from the different film densities behind the individual filters. The number of monthly monitorings in the Federal Republic has grown during the ten years since the introduction of the method to about 25,000. (auth)

41042 PROGRESS IN RADIO-PROTECTION AT THE MARCOULE CENTER. J. Rodier. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 5-10(May-June 1963). (In French)

Radiation protection had to adapt itself successively to all the development stages in the growth of the Marcoule Center. At the same time as the Radiation Protection Service developed, its doctrine was established, and its means and its efficiency increased. In reviewing this evolution the main difficulties encountered are stressed: the action against contamination, the conditioning of radioactive waste, and the disposal of liquid effluents. (auth)

41043 RADIO-PROTECTION IN THE REACTORS G1, G2, AND G3. J.-Ph. Chassany. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 11-17(May-June 1963). (In French)

Radiation protection evolved slowly, in step with the coming into service of the installations. The risks connected with the radiations, the CO_2, and contamination led to the development of efficient means of counteraction: the realization of protections, detection equipment, increase in the personnel, progress in techniques for individual protection, adaptation of the health chain, definition of working zones, etc. Simultaneously the education of the personnel was begun. (auth)

41044 RADIOPROTECTION IN THE PLUTONIUM EXTRACTION PLANT AND ITS ANNEXES FOUR YEARS OPERATING EXPERIENCE. H. Bouzigues. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 19-25(May-June 1963). (In French)

Specialists in charge of the plant and its dependencies under the authority of an engineer are responsible for the action against irradiation and contamination. They ensure that these do not exceed the norms laid down. They are aided in their task by physico-chemists working in laboratories. The protections with which these installations are equipped on the one hand, and the organization of the radiation protection on the other, made it possible to treat industrially enormous quantities of radioactivity, without grave accident to the workers. (auth)

41045 ACTIVITY OF THE DOSIMETRY LABORATORY. R. Tabardel. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 27-34(May-June 1963). (In French)

Methodical and regular control of the external irradiation doses received by agents on active work is carried out. This control is done by the dosimetry laboratory. The systematic dosimetry of β, γ, and x radiations and of rapid and thermal neutrons is based on the use of individual detectors: films and pocket meters. The calculation of radiation doses received by the personnel is carried out by multi-copying methods. The laboratory undertook the dosing of radiations in the case of a criticality accident. (auth)

41046 USE OF RESPIRATORY TRACT PROTECTION APPARATUS IN RADIOACTIVE ATMOSPHERES. G. Langlet. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 35-9(May-June 1963). (In French)

The adaptation of the principles governing individual breathing protection in the development of atomic energy is discussed. Various respiratory protection equipment was tried out on an industrial scale at the Marcoule Center. This study describes the practical results and the solutions which are the result of several years experience. (auth)

41047 ELECTRONIC EQUIPMENT AND RADIATION PROTECTION. S. Cottignies. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 41-6(May-June 1963). (In French)

Protection against nuclear radiation depends on making an exact evaluation of the risks involved. Because of its versatility in use, its precision, and its speed of response, the electronic detector makes possible very varied and complete measurements. For each measurement it is necessary to have a specially adapted apparatus with well-defined theoretical and practical characteristics. The maintenance and repair work is carried out in an electronic workshop which also has to adapt existing apparatus to the particular needs of radiation protection. (auth)

41048 ATMOSPHERIC RADIOACTIVE CONTROL AROUND THE MARCOULE CENTER. R. Estournel and F. Gallissian. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 47-55(May-June 1963). (In French)

The operation of the installations of the Marcoule Center leads to the liberation into the atmosphere of a certain amount of gaseous radioactive effluents. To safeguard the surrounding population, the Radiation Protection Service is charged with the control of the radioactivity of the waste and operates an atmospheric control network consisting of six stations placed within a radius of 25 km around the Center. The interpretation of the results obtained in these stations shows that the influence of the Center, essentially due to the Ar^{41} emitted from the chimney of the reactor G.I., is limited to the regions close to the Center and situated in the prevailing winds. In the zones of maximum influence the total dose due to Ar^{41} represents only $^1/_{10}$ of the norms actually laid down for the population. The control of the long-life atmospheric radioactivity makes it possible as well to follow the evolution of fallout following nuclear explosions. (auth)

41049 THE CHEMICAL LABORATORY AND RADIO-PROTECTION. J. Scheidhauer. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 73-7(May-June 1963). (In French)

After a starting-up period during which the needs imposed by radiation protection had absolute priority, the chemical laboratory of the Radiation Protection Service is now developing in a more clearly defined field. The respective fields of radiation protection and of an analysis team are defined. The three main objects of the laboratory are studied in detail: control, varied research, and methodology. The results obtained during four years operation are a witness to the services rendered by the laboratory during the difficult period of its development. (auth)

41050 THE PHYSICAL LABORATORY AND RADIO-PROTECTION. R. Estournel and Y. Sutra-Fourcade. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 79-81(May-June 1963). (In French)

The control of the final dispersion of the radioactive elements handled in a nuclear center depends to a great extent on the measurement of the radioactivity of dust, gas, and liquid samples. At Marcoule the measurements demanding great accuracy or the use of special techniques are entrusted by the various groups of the Radiation Protection Service to the Physics Laboratory. The methods used and the work carried out by this laboratory are reviewed. (auth)

41051 THE IMPORTANCE OF STATISTICAL METHODS IN RADIOPROTECTION. R. Court. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 83-9(May-June 1963). (In French)

The existence of permissible norms for exposure to the various ionizing radiations makes it possible to solve theoretically the protection problems posed by the industrial exploitation of atomic energy. The danger for persons working in the atomic centers or living nearby depends on a certain number of specific factors such as the operational characteristics of the installations, the place where individuals work or live, and meteorological considerations.

Since the importance of these factors cannot be fixed a priori, the determination of the real detrimental effects of the installations necessitates the carrying out of a practical study of the conditions to which the persons are exposed. Routine radiation protection controls carried out at the Marcoule Center give the necessary elements upon which such a study can be based. This latter is characterized by the large number of figures to be analyzed and by the diversity of the conditions in which the results are obtained. It requires the use of statistical methods whose application makes it possible to carry out in the best possible conditions the synthesis of all the data collected. (auth)

41052 INFORMATION AND EDUCATION IN RADIOPROTECTION. J. Rodier, J. Castan, and C. Guerin. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 91-7(May-June 1963). (In French)

Protection against ionizing radiation becomes very efficient only if the workers and the population are aware of its role and of its possibilities. This implies an education of individuals which becomes a professional training in the case of workers charged with applying the protection. To attain this objective audio-visual techniques were used, in parallel with conventional teaching methods. (auth)

41053 THE DECONTAMINATION OF EQUIPMENT AND CLOTHING. P. Boutot. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 99-106(May-June 1963). (In French)

The atomic industry inevitably leads to the contamination of certain equipment. The personnel also run risks of contamination from which they are protected by the wearing of special clothing. The contaminated equipment and clothing are treated at the Marcoule Center by essentially chemical methods in a damp medium. For the equipment, besides acids and bases, the products used are grease removers, pickling solutions, or detergents, all used hot. Lead is treated by a special method based on fusion. For the clothing, a prior electronic sorting determines the treatment to be applied. Generally speaking, at the same time that the washing is done the radioactive elements are complexed for elimination in the liquid phase. The technique used is based on the counter-current principle. There is a very strict control at the exit to check that only material and clothing satisfying the norms is sent back into circulation. (auth)

41054 THE SERIOUS RADIOACTIVE ACCIDENT AND RADIOPROTECTION METHODS. R. Estournel and J. Rodier. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 115-20(May-June 1963). (In French)

During a serious radiation accident, radioactive dust and gases may be released into the atmosphere. It is then essential to evaluate rapidly the extent of the risk to the surrounding population, and to carry out radiation analyses and personnel decontamination. Mobile detection teams were set up and a trailer laboratory and also mobile showers were built. After defining the task of the mobile teams, a description of the emergency equipment which would be used by the Marcoule Center in the case of a serious radiation accident is given. The methods of using this equipment are also described. (auth)

41055 SIGNIFICANT INCREASE OF MANGANESE-54 IN RADIOACTIVE FALLOUT. A. Malvicini, M. de Bortoli, P. Gaglione, and F. Van der Stricht (C.C.R. Euratom, Ispra, Italy). Comit. Nazl. Energia Nucl., Notiziario, 9: Nos. 8-9, 44-51(Aug.-Sept. 1963). (In Italian)

In the last two years the concentration of Mn^{54} in fallout has significantly increased. The presence of Mn^{54} was disclosed by gamma spectrometry on samples of fallout, vegetables, meadow grass, grasses, and sea life. Typical gamma spectra are shown. (J.S.R.)

41056 DECONTAMINATION WITH MOBILE WATER-TREATMENT PLANTS IN EMERGENCY. K. F. H. Mehls. Gas-Wasserfach, 102: 1365-9(1961). (In German)

Methods and plants for emergency treatment of water in the field are described. Methods include the use of suspended contact filters, chlorination with electrolytic production of chlorine, and ion exchange. Problems of radioactive pollution are also discussed. (OTS)

41057 RADIATION PROTECTION IN DIAGNOSTIC X-RAY DEPARTMENTS OF DISTRICT HOSPITALS. P. F. Mathias (Armed Forces Medical Coll., Poona, India). Indian J. Radiol., 15: Suppl., i-x(Nov. 1961).

The somatic and genetic effects of radiation are reviewed. Difficulties in maintaining adequate personnel and patient protective measures in diagnostic x-ray rooms of smaller hospitals in India are discussed. In some district hospitals the x-ray rooms were observed to be crowded with patients awaiting their turn as well as relatives of the patient. Activities of the Atomic Energy Establishment of India in personnel monitoring and protection surveys are discussed. (C.H.)

41058 SIMPLE RULES FOR PROTECTION AGAINST RADIATION. Cyril J. Albert (Christian Medical Coll., Hospital, Vellore, India). Indian J. Radiol., 17: 33-6(Feb. 1963).

The biological effects of radiation are reviewed and the latest recommendations of the International Commission on Radiological Protection concerning maximum permissible dose are outlined. Sources of radiation are discussed. Rules are given for the protection of both patients and medical personnel during diagnostic and therapeutic uses of radiation. (C.H.)

41059 TRITIUM FALLOUT OVER NORTH AMERICA FROM THE SOVIET TESTS IN 1961. L. L. Thatcher and C. M. Hoffman (Geological Survey, Washington, D. C.). J. Geophys. Res., 68: 5899-5901(Oct. 15, 1963).

Measurements made over North America in late 1961 and early 1962 indicate a major increase of tritium fallout that began in late Oct. 1961. The increase continued through the winter and reached a peak in the spring of 1962. The increase of tritium fallout in the coastal areas is relatively low compared with the sharp increase in the interior of the continent. The tritium concentration in surface waters of North America is also shown. (C.E.S.)

41060 THE PRACTICAL ORGANIZATION OF RADIATION PROTECTION. Janos Barany and Karoly Hegedus. Magy. Radiol., 15: 208-14(Aug. 1963).

A brief survey of the problem of radiation protection is given. Deficiencies and the steps required for their correction are discussed. (TCO)

41061 A DETECTOR FOR THE TESTING OF LARGE-SURFACE CONTAMINATIONS. Daniel Vodros and Gyorgy Gyenge. Magy. Radiol., 15: 247-9(Aug. 1963).

A very sensitive apparatus was constructed for the protection of employees working with open sources of radiation. The detector is also suitable for the detection of β and α radiation. Contamination of the body, clothing, or instruments by isotopes can be checked at any time and radiation injury can thus be prevented. (OTS)

41062 CERTAIN PUBLIC HEALTH PROBLEMS IN THE TREATMENT OF PATIENTS INJURED BY IONIZING RADIATION. Vojislav Plecas. Nar. Zdravlje, 19: 196-201(1963).

The etiopathogenesis of damage to the organism from ionizing radiation, pathogenetic classification of such diseases (hematopoietic, gastrointestinal, and cerebral forms), pathological and anatomical changes taking place, clinical phases, the bases of diagnosis, possibilities of treatment, and the task of the physician in an emergency situation are discussed. (OTS)

41063 BEHAVIOR OF STRONTIUM-90 AND CESIUM-137 IN THE BREWING OF TEA. G. Kistner and R. Ritter (Bundesforschungsanstalt fur Lebensmittel-frischhaltung, Karlsruhe, Ger.). Naturwissenschaften, 50: 572(1963). (In German)

The Sr^{90} and Cs^{137} contents in three commercial teas were determined before and after 5-min. brewing in boiling tap and distilled water. In the original tea samples, the Sr^{90} concentration was between 250 and 560 pC/kg, and the Cs^{137} concentration was between 820 and 1205 pC/kg. The mean activity after brewing was 90 pC Sr^{90} or 740 pC Cs^{137}/kg original tea. There was no significant difference between the distilled and tap water. There is a decontamination factor of 0.2 for Sr^{90} and 0.7 for Cs^{137} in boiling tea. (J.S.R.)

41064 STUDIES OF THE RADIOACTIVE DEBRIS AT HIGH ALTITUDE. Tatsuo Urai. Nippon Genshiryoku Gakkaishi, 5: 735-41(Sept. 1963).

Studies of the concentration of radioactive airborne debris at altitudes of 8 ~ 12 km caused by nuclear tests were made using F-86-F jet airplanes. Since Oct. 1961 changes of the concentrations of radioactive debris in the stratosphere at different latitude, altitude, and time of sampling were observed. It was found that during about 5 months following the nuclear explosions, the change of the concentrations with latitude was remarkable, and that the concentrations in Hokkaido were about 10 times as high as those in Kyushu. (auth)

41065 SCATTERED RADIATION IN DIAGNOSIS AND TREATMENT, IN RELATION TO PROFESSIONAL RISK. G. Caretti and G. Chianura (Universita, Bologna). Radiol. Med., 49: 668-83(Aug. 1963). (In Italian)

From the quantitative point of view, the exposure dose due to scattered radiation incident on operators in radiodiagnosis is, on the average, ten times greater than that in radiotherapy. In contrast, from the qualitative point of view, the first half value layer of the incident scattered radiation in radiodiagnosis can be considered approximately ten times less than that occurring in conventional roentgenotherapy, and one hundred times less than in the case of high energy radiation therapy. As it is practically impossible to measure the absorbed dose, directly, it is considered advisable to combine the measurement of the exposure dose with determination of the first half value layer of the scattered radiation, in order to obtain more correct information about the dose absorbed by professional radiologists and technicians. (auth)

41066 CESIUM-137 IN ALASKAN ESKIMOS. Harvey E. Palmer, Wayne C. Hanson, Bobby I. Griffin, and William C. Roesch (General Electric Co., Richland, Wash.). Science, 142: 64-6(Oct. 4, 1963). (HW-SA-2869)

During the summer of 1962, levels of radioactivity in over 700 people at four villages above the Arctic Circle in Alaska were measured with a transportable whole-body counter. The averages for body burden of cesium-137 were much higher than the average for people in the rest of the United States. The people of the interior village of Anaktuvuk Pass had the highest average burden of cesium-137, which was 421 nanocuries; the maximum burden was 790 nanocuries. (auth)

41067 CESIUM-134 IN ALASKAN ESKIMOS AND IN FALLOUT. Harvey E. Palmer and Richard W. Perkins (General Electric Co., Richland, Wash.). Science, 142: 66-7(Oct. 4, 1963). (HW-SA-2973)

Whole-body counts of Alaskan Eskimos during the summer of 1962 showed the presence of cesium-134 as well as cesium-137. Cesium-134 was also found in reindeer and caribou meat; this finding was confirmed through coincidence counting. There was generally about 1 percent as much cesium-134 as there was cesium-137. Cesium-134 was also found on air filters collected at Richland, Washington. The appearance of cesium-134 seems to be world-wide and continuing. (auth)

41068 FALLOUT RESEARCH IN THE AREA OF VIENNA FROM SEPTEMBER 1, 1961 TO JUNE 30, 1963. Othmar Preining, Martin Sedlacek, Friedrich Ernst, Werner Resch, and Johann A. Schedling (Universität, Vienna). Staub, 23: 407-12(Sept. 1963). (In German)

Results of the measurements of the β activity of fallout, the frequency of the occurrence of hot particles in relation with the explosion dates of nuclear weapon research, the grain-size distribution of radioactive aerosols, and γ spectrometric studies are reported. All results in this time period, with one exception and disregarding quantitative variations, showed no basically new results in comparison with earlier research series. Detailed knowledge on the grain-size distribution of the radioactive aerosols were obtained through the combined use of cascade impactor and aerosol spectrometric studies and autoradiographic methods. The origin for the occurrence of a steep activity increase in November 1962, which can be explained only slightly by a nuclear explosion in one of the traditional research sites, remained unclarified. (tr-auth)

41069 SIZE SPECTRA OF RADIOACTIVE AEROSOLS. Gerhard Schumann (Universität, Heidelberg). Staub, 23: 412-16(Sept. 1963). (In German)

In the investigation of radioactive aerosols, the size distribution of the particles is of significance both for the effects to be taken into consideration for radiation protection and for the measurement techniques. The radioactive aerosols in the atmosphere were reported. The grain-size distributions were investigated with the Goetz aerosol spectrometer under various conditions. Natural RaB + C aerosols, which arise through accumulation of Rn decay products, common atmospheric aerosols charged with ThB, and fission product aerosols arising from nuclear test explosions were the particles studied. The results were compared with semi-empiric calculations and with data obtained from the literature. (tr-auth)

41070 FILTER MEASUREMENTS AND GAMMA SPECTROSCOPIC ANALYSES OF ARTIFICIAL AIR RADIOACTIVITY SINCE AUTUMN 1961. Hans Grueter (Universität, Munster, Ger.). Staub, 23: 416-19(Sept. 1963). (In German)

The artificial radioactivity of the atmosphere near the ground was monitored by batch filter measurements from September 1961, to June 1963. The focal point of the studies was the γ-spectrometric analysis of the fission products since their chemical composition is of significant effect of the biological effects. The γ spectra were recorded with a simple oscillographic spectrometer. With this apparatus it was possible to measure and analyze the composition of the fission products varying with time. (tr-auth)

41071 MEASUREMENTS OF THE PENETRATION DEPTH OF RADIOACTIVE-LABELED AEROSOLS IN FILTERS FOR SUSPENDED MATERIAL. Albert Sittkus and Klaus Backheuer (Max-Planck-Institut für Kernphysik, Heidelberg). Staub, 23: 419-23(Sept. 1963). (In German)

Direct measurements of the distribution of absorbed aerosols were made on various filter types. The atmospheric aerosols were labeled with ThB and the range and energy distribution of the α rays emitted from ThC' was measured. The method makes possible the investigation of the absorption in surface layers up to about 4 mg/cm^2 mass or about 100 μm thickness and permits conclusions on the structure of these layers. Measurements of the penetration depth as a function of the flow velocity show that in membrane filters electrical charges formed in the flow-through have a considerable effect on the aerosol absorption. (tr-auth)

41072 MEASUREMENT OF THE SPONTANEOUS ACTIVITY EMISSION OF TRITIUM-LABELED LUMINOUS PIGMENTS AND PAINTS. Wilfried Coenen (Gewerblichen Berufsgenossenschaften e.V., Bonn). Staub, 23: 424-30 (Sept. 1963). (In German)

A measurement device for the determination of the emission of volatile tritium compounds from tritium-labeled luminous pigments and paints is described. In addition to the dependence of the activity emission on the specific tritium activity of the luminescent material or its luminescent density, a mathematical prediction on the equilibrium distribution of the volatile activity can be made. It is shown that the distribution of the volatile tritium compounds that results in an accumulation of a part of the activity emitted on the luminous paint. The effect of activity distribution on the activity emission was eliminated or corrected and an attempt was made to interpret the activity distribution theoretically. Because of the significance of volatile radioactive compounds from luminous materials on radiation protection, an estimation was made of the luminous paints that can be stored in working places. (tr-auth)

41073 CONTROL OF RADIOACTIVE CONTAMINATION OF WATER. PART I. BASIS, REGULATIONS, PRINCIPLE OF DIRECT MEASURING. Sigfrid Mueller (Frieseke and Hoepfner GmbH, Erlangen, Ger.). Tech. Ueberwach., 4: 371-3(Oct. 1963). (In German)

The control of the maximum permissible concentrations for radioactive matters requires unobjectionable measuring methods and equipment. Methods of direct measurement and measurement according to the enrichment process that may be used to determine the concentration values of alpha, beta, and gamma activities in water are described. (auth)

41074 SBORNIK RABOT LABORATORII BIOFIZIKI. IV. RADIOKTIVNYE ZAGRYAZNENIYA BIOSFERY I MERY BOR'BY S NIMI. (Compilation of Laboratory Works on Biophysics. IV. Radioactive Contamination of the Biosphere and Protective Measures Against It). V. N. Petri, ed. Tr. Inst. Biol., Akad. Nauk SSSR, Ural'sk. Filial, No. 22, 1-91(1962).

Six articles are included on radioactive contamination of the biosphere and protective measures against it. The first article reviews radiation effects on living organisms, genetics, and contamination of open water basins. The second treats radiation effects in soils and the third the distribution of radioactivity in soil and its uptake by biomasses and structures. Radiation uptake by fresh water organisms and principles of biological decontamination of sewer waters are discussed in the fourth article. The fifth and sixth articles, respectively, consider the problems of radioactive isotope separation from organisms and the genetic significance of increased fallout. (R.V.J.)

41075 IONIZING RADIATIONS—THE SIZE OF THE PROBLEM. R. F. Farr. Trans. Assoc. Ind. Med. Officers, 13: 2(Apr. 1963).

The maximum permissible dose of exposure to radiation from non-medical sources was determined for the general public, taking into account exposure to natural and medical sources. A figure was also established for the annual rate of exposure for radiation workers, and a third factor is the maximum permissible body burden of radioactive materials as a source of internal radiation. From these three fundamentals, recommendations, and regulations that govern the industrial, medical, and scientific uses of radiation were constructed. (TCO)

41076 RADIOACTIVE FALLOUT IN PRAGUE IN 1962. Kvetoslav Spurny and Oldrich Machala (Inst. of Physical Chemistry, Czechoslovak Academy of Sciences, Prague). Zdravotni Tech. Vzduchotech., 6: 147-9(1963).

Data on the radioactive fallout in Prague measured during the whole year of 1962 and their relation to the testing of nuclear weapons are given. The total fallout of radioactive aerosols in 1962 was 301 millicuries per square kilometer (1958: 450; 1959: 295; 1960: 50; 1961: 203). (OTS)

41077 AL'FA-, BETA-, GAMMA- I NEITRONNYE IZLUCHATELI DLYA KONTROLYA I GRADUIROVKI DOZIMETRICHESKOI I RADIOMETRICHESKOE APPARATURY. (Alpha, Beta, Gamma, and Neutron Emitters for Control and Scaling Dosimetric and Radiometric Devices). G. N. Inikhov. Moscow, Gosatomizdat, 1963. 80p.

A small reference book is given on the standardization of measuring methods for α, β, γ, and neutron emitters used with dosimetric and radiometric devices. (R.V.J.)

41078 STRAHLENSCHUTZ UND DOSIMETRIE IN DER KERNTECHNIK. (Radiation Protection and Dosimetry in Nuclear Technology). Helmut Abel, Werner Rossbander, and Erika Tolkendorf. Leipzig, VEB Deutscher Verlag für Grundstoffindustrie, 1963. 116p.

The interaction of solids and radiation is considered. The dose concept and the principle of dose measurement, the effect of radiation on organisms, radiation protection against sealed and open radiation sources, and measurement devices commonly used are discussed. (tr-auth)

41079 RADIOLOGICAL HEALTH DATA [MONTHLY REPORT], VOLUME IV, NUMBER 5. (Public Health Service, Washington, D. C.). May 1963. 50p. $0.50(GPO). (RHD-Vol.IV, No.5)

Data are presented on the radioactivity in samples by airborne particulates, precipitation, and surface waters collected throughout the U. S. and other locations during 1962 and 1963. Data are included on the content of Sr^{89}, Sr^{90}, and I^{131} in milk samples from various locations, the environmental levels of radioactivity at Argonne National Laboratory and the Portsmouth Area Gaseous Diffusion Plant during 1962, and the Shippingport Atomic Power Station during the second half of 1961 and the first half of 1962. Results are reported from a survey of radioactivity emitted by luminous dial watches. Only one nuclear detonation was announced during April 1963. Characteristics of the detonation are summarized. (C.H.)

41080 SITING OF REACTORS AND NUCLEAR RESEARCH CENTRES. Proceedings of the Symposium on Criteria for Guidance in the Selection of Sites for the Construction of Reactor and Nuclear Research Centres Held at

Bombay, 11–15 March 1963. (International Atomic Energy Agency, Vienna). Proceedings Series. July 1963. 516p. (STI/PUB/72). $10.00; Sch 210,-; 60s.stg; NF 40,-; DM 35,-(IAEA)

Thirty papers are included; separate abstracts have been prepared for 25. Five papers were previously abstracted in NSA. Twenty-three are in English, 6 in French, and 1 in Spanish. (T.F.H.)

41081 ENVIRONMENTAL ASPECTS OF NUCLEAR-FACILITY SITE SELECTION. J. A. Lieberman (U. S. Atomic Energy Commission, Washington, D. C.), D. A. Pack, and E. S. Simpson. p.43-53 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

A dominating factor in nuclear facility site selection is the protection of the public health and safety and natural resources. Two major input terms are involved in the site selection process: the nature and characteristics of the facility in relation to its release (or potential release) to the environment of radioactive materials either by accident or design; and the nature and characteristics of the specific environment in which the facility may be located. Obviously a large number of variables are involved in these two terms. It is possible to evaluate a site by applying, in a formal way, certain fixed specifications as, for example, making the size of the exclusion area some fixed function of reactor power. Although this approach is undeniably objective, the factors involved are many, highly variable, and complex, and specific quantitative information regarding many of the factors is lacking. It is feared that formal application of specifications would merely indicate whether or not the site satisfied the specifications, and little or no insight into site characteristics and safety would be obtained. In addition, it can be argued that establishment of such specifications would indicate a degree of knowledge that may not exist or is not supported by experimental or operating evidence and also would inhibit the development of new and improved techniques and information in this field. The environmental aspects of site selection are examined, and the main features of an environmental analysis of a proposed site or sites are indicated to assist in reaching appropriate conclusions on the relative suitability of sites for nuclear facilities. Subsequent site evaluation, which is related to the amount and nature of radioactive material contained in the facility system and the nature and purpose of the facility, is also discussed. (auth)

41082 A METHOD FOR ESTIMATING THE UPPER BOUND OF THE INHALATION RADIATION DOSE FROM REACTOR STACK DISCHARGE. F. T. Binford (Oak Ridge National Lab., Tenn.). p.67-77 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

Among the problems associated with the selection of a reactor site is that of estimating an upper limit to the yearly internal radiation dose to the surrounding population as a result of the routine release of airborne fission products. The concentration χ of fission products in the atmosphere, owing to continuous release from a stack, may be represented by the Gaussian plume formula. Upon multiplying χ by the breathing rate and the dose per inhaled microcurie, the internal dose-rate owing to inhalation may be obtained. The dispersion parameters vary in form with atmospheric stability, which in turn varies in a complicated way with time. Moreover, other parameters vary in a random manner with time. Thus, integration of χ over time to obtain the total dose per year would be quite difficult. Moreover, the use of average values for the parameters, thus simplifying the integration, will not necessarily result in a correct or even a conservative result. A conservative result can be obtained by assuming that the emission rate has a constant unit value, applying to it an appropriate term to account for decay and calculating the concentration at each point down wind for that wind speed that maximizes the concentration at that point. This calculation is performed for each stability condition, that is, for each set of values of the dispersion parameters. The curves thus obtained are plotted on a single graph, and the envelope of these curves gives an upper bound to the concentration that results from unit discharge at the stack at each point down wind. By utilizing the frequency distribution of wind direction and the dose delivered per inhaled microcurie, and then multiplying by the time, an upper bound to the inhalation dose due to unit discharge to be expected at each point in the vicinity can be found. These results can then be used to set exclusion areas, stack heights, and discharge rates. (auth)

41083 ARRANGEMENTS FOR THE MONITORING OF ENVIRONMENTAL RADIOACTIVITY IN CONJUNCTION WITH SAFETY SURVEYS OF NUCLEAR SITES. A. Menoux, P. Bovard, and A. Doury (Centre d'Etudes Nucleaires, Saclay, France). p.79-88 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In French)

In France, proper environmental radioactivity monitoring of nuclear sites is considered a main factor to be taken into account in the surveys needed in connection with the selection of such sites. Certain guiding principles emerge. Environmental radioactivity monitoring must be very closely linked with the site-safety investigations prior to start-up, during normal operation, and in the event of any accidental release that may take place. During the preliminary site surveys carried out before operations begin it is necessary to define diffusion and dispersion parameters and the parameters of settling or reconcentration in various media: atmosphere; water; soil; and so on. It is then that locations have to be selected for systematic sampling, for continuously recording monitoring stations and, possibly for mobile monitoring stations. Examples are given to illustrate the value of having reference points that are carefully chosen in relation to the proposed sites with a view to keeping a check on changes in the existing radioactivity levels. (auth)

41084 DESCRIPTION OF THE TOKAI SITE AND MONITORING SYSTEM ON SITING A REACTOR. I. Miyanaga and T. Aoki (Japan Atomic Energy Research Inst., Tokyo). p.89-105 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

There are now three research reactors and three critical assemblies at the Tokai site, in addition to the JPDR (45 Mw(t)) expected to be in operation this year. Furthermore, a power reactor (Calder Hall type, 585 Mw(t)) is being constructed there by the Japan Atomic Power Company. A fuel processing plant and one more reactor (MTR) may be added at or near the site in the future. The site area is described with regard to features affecting the siting of a reactor in Japan, and, independent of site criteria, emphasis is placed on positive efforts being made to minimize hazards to the general public from any accident. As an approach to this problem the principle of a monitoring system is described for the rapid evaluation of an accident, and the advantages of this system are discussed in relation to the siting of a reactor. (auth)

41085 POWER-REACTOR DESIGN EVALUATION FROM THE STANDPOINT OF RADIATION SAFETY FOR A GIVEN SITE. S. D. Soman, L. V. Krishnan, T. Subbaratnam, and D. V. Gopinath (Atomic Energy Establishment, Trombay, India). p.107-31 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

The site chosen for India's first atomic power station is at Tarapur on the west coast of India about 100 km north of Bombay. The suitability of the site for four reactor designs, namely, the GCR, PWR, BWR, and CANDU is evaluated from the standpoint of radiation safety. It is observed that adequate provisions are usually made in all the designs so that during normal operation of the reactor the radiation hazards to plant personnel and the general public in the environment are not significant. To evaluate the effect on the environment of the release of fission products from the reactor building under maximum credible accident conditions, local meteorological parameters are used. The ground level releases that would lead to the specified permissible radiation levels at various limiting distances for the site are calculated for lapse and inversion conditions. Analysis of this data in terms of the accompanying I^{131} release leads to the value of 980 C I^{131} as the Acceptable Site Radiological Burden (ASRB) for ground release. With a view to limiting the ground release to a period of about 8 hr, it may be necessary to discharge some activity by means of an emergency ventilation system, through a stack. External exposures caused by such a release of noble gases through a 100-m stack after a hold-up time of 8 hr are within permissible limits. However, to limit doses to the thyroid from the stack release it is essential to provide for a reduction factor of 10^4 for the iodines. This factor is easily attainable by the incorporation of carbon-bed filters in addition to the absolute filters in the emergency ventilation system. From knowledge of the core inventories and the release coefficients from damaged fuel, the probable releases of I^{131}, Cs^{137}, Sr^{89}, and Sr^{90} activities under maximum credible accident conditions are estimated for all the four reactor systems, and found to be below the acceptable values, except for I^{131}. With the deposition and plate-out of iodines considered, the I^{131} release is also less than the ASRB value. It seems that under maximum credible accident conditions, the fission-product releases from any of the four reactor types considered can be brought within acceptable values by suitable containment provisions. The combined radiation exposures resulting from ground and stack releases would then be within acceptable limits for the general population residing in the neighborhood of the Tarapur site. (auth)

41086 LOCATING NUCLEAR-POWER PLANTS WITH REFERENCE TO ENVIRONMENTAL SAFETY. J. M. Smith, Jr. (General Electric Co., San Jose, Calif.). p.133-45 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

Useful locations for large nuclear plants must satisfy basic economic requirements, including proximity to electrical load, transmission lines, cooling water, and general suitability for construction and operation. If several potential sites are considered feasible for economic requirements a contribution to public safety can be made by considering the relative physical advantages of the several sites. The inventory of hazardous radioisotopes in an operating reactor makes it essential that both the plant design and its location be optimized to provide a high degree of assurance of public safety. The containment barriers of the plant are expected to provide complete protection, even in the event of serious failure of the reactor system. It is only in the multiple contingency of failure of the containment barriers, in addition to failure of the reactor system, that plant location provides an important contribution to safety of the environment. For such eventualities, the consequences of the escape of significant quantities of fission products into air and water require evaluation. A numerical "site-rating index" is presented to weigh the relative advantages of several potential sites that are suitable economically. For airborne release, factors formulated into the index include the proximity of the surrounding population, variations in value indicated by land use, meteorological probabilities of various wind directions, velocities, atmospheric diffusion conditions, and the effect on airborne transport of topography and land cover. For waterborne release, comparisons may be made based on the expected diffusion and movement in the affected waterway and on the significance of suddenly interrupting its many uses. Such judgments based on serious accidents usually indicate the location that is also most suitable for routine operating gaseous and liquid waste disposal. The rating method is illustrated on selected sites currently used for nuclear power in Europe and America. The index indicates those sites where greater reliance on engineered protection features in the plant design is appropriate to compensate for any unfavorable physical conditions at the proposed location. (auth)

41087 THE DISPOSAL AND STORAGE OF RADIOACTIVE SUBSTANCES AND REPERCUSSIONS ON THE CHOICE OF NUCLEAR SITES. F. Duhamel (Centre d'Etudes Nucleaires, Saclay, France). p.149-65 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In French)

Every nuclear installation produces some radioactive waste. Once it increases to a certain size (because of the variety of the work carried out, or the volumes of radioactive sources handled or processed), these wastes can no longer be transported in the form in which they are produced. They must consequently either be disposed of untreated, or be so treated as to produce one of two types of waste, processed for storage and ready for disposal. Three factors — transport, storage, and disposal — have therefore to be considered at each nuclear site and they apply to gaseous, liquid, and solid wastes. The cost of processing, transport, or disposal will depend upon local geological, hydrological, and atmospheric conditions, and on local human and political factors, which also have a direct bearing on the choice of processing techniques. The choice of site is obviously related to the safety requirements of the various facilities it is proposed to install, and many of these requirements are connected with radioactive-waste problems. (auth)

41088 SOME TECHNICAL QUESTIONS ARISING FROM THE STUDY OF A DEVICE FOR DECONTAMINATING RADIOACTIVE EFFLUENTS THAT USES SOIL TAKEN FROM AN ATOMIC SITE OR ITS IMMEDIATE NEIGHBORHOOD. J. Bourrier (Centre d'Etudes Nucleaires, Fontenay-Aux-Roses, France). p.167-80 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In French)

Some problems involved in using a concrete tower, filled with earth taken from an atomic site, for the decontamination of radioactive effluents from installations on that site are studied. It is shown that by careful selection of the tower's dimensions the cost can be considerably reduced

(ratio 7:1). Determining the tower's filtration coefficient too hastily beforehand is shown to be unwise. Some considerations regarding the way in which the distribution of the radioactive ions retained alters, particularly in relation to the speed of percolation, underline the physico-chemical aspect of the problem. A formula is given that should provide an order of magnitude for the irradiation in the neighborhood of the device when it is not buried. (auth)

41089 IMPACT OF SITING OF ATOMIC ENERGY ESTABLISHMENTS ON AGRICULTURAL INTERESTS. G. Wortley (Food and Agriculture Organization of the United Nations, Rome). p.181-200 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

The hazards that can occur in the agricultural field owing to the location of atomic energy centers, and also any benefits that could accrue, are considered. The hazards are those to which populations in the environment of the sites might be subject through radiation exposures of all kinds, mainly from the disposal of radioactive wastes, with the possible resultant contamination of food. The part to be played by agricultural authorities responsible for protecting the interests of food and agriculture is mentioned, and the nature of the effort required in carrying out such supervision is discussed. Because any discussion of food in this context should include fish and seafoods, their position in the general scheme of protection is included, bearing in mind that in some countries agriculture and fisheries interests are combined in one department. The position with regard to the safety achieved so far is discussed, and an attempt is made to put this radiation hazard in proper perspective by comparison with other risks accepted by man as necessary but unavoidable because of the benefits that accrue. The benefits to agriculture directly from atomic energy are touched upon. These considerations lead to the view that it is doubtful whether the beneficial applications to agriculture could influence to any degree the siting of atomic energy establishments unless they are specially developed for the purpose, as in the field of the preservation of food by ionizing radiations, and where reactors specifically designed for this purpose are suggested. These applications are, however, in the future. There are, however, some other minor advantages to be gained in siting atomic energy establishments close to or in the same region as agricultural research centers, and these are discussed. It is shown that records indicate that agriculture has little to fear and much to gain from the successful development of an atomic energy industry. (auth)

41090 CONTAINMENT AND POWER-REACTOR SITING. V. V. Shirvaikar and A. K. Ganguly (Atomic Energy Establishment, Trombay, India). p.211-44 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

The selection of a site for a nuclear-power station needs compromise between two mutually-contradictory requirements. While, for economic reasons, the station should be near the consumers, for safety reasons it should be located far from them. The systematics of power-reactor siting and evaluation of the site-reactor combination are described. The acceptable emergency dose (AED) limits for reactor siting should be based on somatic and not genetic exposure. The acceptable emergency dose should be such that it will not result in recognizable somatic injury to the public exposed. This restricts the genetic burden of the whole population to below the acceptable limits set by the International Commission on Radiological Protection (ICRP). Technology should demonstrate that, at a given site, any activity released from a reactor under maximum credible accident conditions shall not exceed AED limits to warrant evacuation. A concept of acceptable release in emergency (ARE) is expounded, and computations and examinations are made of the maximum acceptable power of a reactor for location at a given site; the overall containment factors required to limit the iodine release to correspond to ARE values; and the feasibility of obtaining the desired containment level for the power-reactor plants. The necessity is pointed out for evaluating the post-accident containment capability of a reactor design. Emphasis is placed on the need for provision to be made in the design for practically complete containment of liquid radioactive wastes which may be generated in a maximum credible accident. The stringent requirement of containment capability is considered to be within the bounds of technological capability and to be economically attainable. The suitability of a site should therefore be specified in terms of power-plant design rather than in general terms. This approach obviously requires a critical study of credible accidents and containment analysis of the system. Such an approach indicates the suitability of a site in a technical and economical perspective and provides flexibility in the choice of reactor sites near populated areas when the design can reasonably assure the required degree of containment. (auth)

41091 A REVIEW OF CONTAINMENT SCHEMES FOR WATER REACTORS. R. O'Neil and A. R. Edwards (United Kingdom Atomic Energy Authority, London, Eng.). p.245-75 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

For a given reactor it is usually possible to postulate circumstances which can lead to release of fission products from the system. For a particular site it is possible, by surveying local conditions, to arrive at a figure for the size of release that will not expose the public to an unreasonable hazard. In general terms, any discrepancy between possible release and this acceptable release leads to the necessity for containment that will include the building characteristics, pressure venting or reducing systems, clean-up plants, etc. Possible variations of containment type are briefly examined, for example pressure-tight, pressure-vented, or pressure-suppressed. The range of basic parameters to be investigated by the designer are briefly enumerated, such as initial peak pressure, rate of coolant discharge, heat transfer and chemical reactions, decay heat effects, leakage of activity, etc. Under each heading the state of knowledge and its limitations is examined. It is usually not possible to provide a leak-proof containment for the airborne fission products and means must be provided to terminate the release as soon as possible. This can be achieved by either immobilizing the fission products or by removing the driving pressure which is producing the leakage or both. Present knowledge on filtering, plating, and absorption techniques tends to the conclusion that removal of the pressure differential may be the preferred way of terminating an accident. The use of a double containment structure can give protection to emergency plant from mechanical damage and by providing a hold-up space, will avoid the necessity for designing an emergency plant to be instantaneously and continuously available. Although no clean-up for rare gases is proposed, the hold-up in the secondary containment gives time for radioactive decay and, in the early stages, provide valuable reduction in leak-rate by dilution. Worked examples of both single

and double containment schemes for the same postulated accident are discussed. (auth)

41092 SITE CRITERIA FOR REACTORS WITH MULTIPLE CONTAINMENT. W. K. Ergen (Oak Ridge National Lab., Tenn. and U. S. Atomic Energy Commission, Washington, D. C.). p.277-86 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

In the United States the practice in power-reactor site selection is usually dominated by concern regarding atmospheric pollution by radioiodine in the case of a maximum credible accident. The exclusion radius, the radius of low-population zone, and the population-center distance increase as (reactor power)$^{\frac{1}{2}}$ and become burdensome for high-power reactors. If engineering safety features could eliminate the release of iodine and particulates, potential pollution would be dominated by radioactive rare gases, and the reactor power, compatible with a given site, would increase by a factor of 20 or more. Since these gases decay rapidly, hold-up of the releases would bring further improvement. Multiple containment is one of the devices to drastically reduce the release of iodine; it can also introduce a delay into the rare-gas release. The general principles involved are discussed and specific examples are given, such as the Consolidated Edison Thorium Reactor, the N.S. Savannah, and others. (auth)

41093 ENGINEERING CONSIDERATIONS AS APPLICABLE TO SITING OF NUCLEAR-POWER REACTORS IN INDIA. V. N. Meckoni and R. P. Mehta (Atomic Energy Establishment, Trombay, India). p.287-95 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

One of the basic considerations in the selection of sites for nuclear-power reactors is the demand for power in any given region and the availability of alternative sources of energy to meet the demand. In the assessment of the hydroelectric resources in the area the firm potential, as well as the time required for the implementation of hydro schemes, have to be taken into account. When assessing the possibility of utilizing fossil fuels for the generation of power, the availability and cost of fuel, as well as adequacy of transport, must be considered. The location of the station should permit interconnection to an integrated grid system with a minimum of new transmission lines. From considerations of stability a strong grid is essential to allow the use of more economic larger unit sizes of reactors and generating plant. The availability of an adequate supply of cooling water, from the sea near coastal locations, or from fresh water sources for inland sites, is essential. Water should preferably be within the siphon head with minimum daily or seasonal fluctuation in the level, should be free from silt, and should be at a relatively low temperature. Other requirements such as good foundation conditions, access to the site, the availability of construction power supply, a sufficient area of level land, a low sub-soil water level, proximity to sources of construction materials, etc., have to be taken into consideration also. A number of possible sites in the north, west and south of India are evaluated to ascertain their suitability for locating nuclear-power stations. A total of seven sites are recommended on the basis of these investigations. (auth)

41094 HEALTH AND SAFETY CRITERIA FOR SITING POWER REACTORS IN INDIA. A. S. Rao, P. R. Kamath, and A. K. Ganguly (Atomic Energy Establishment, Trombay, India). p.299-316 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

The nuclear safety criteria for siting power reactors in India are discussed by the authors. These criteria are based on the emergency exposure dose to the general population from direct radiation, inhalation, and contamination of the environment. Assuming accident conditions in the reactor, and the partial release of radioactive fission products from containment to the environment, under adverse climatic conditions, three radiation zones around the power station are defined to keep the exposure of the general public to a minimum. The exclusion area is the region up to 1.6 to 2.4 km from the station, which is entirely restricted to plant operations. The sterilized area is up to 5 km from the site where the growth of public activity is controlled. The outlying areas are up to 16 to 50 km, where large centers of population are not desirable. Several sites are examined in Western, Central-Northern, and Southern India to locate nuclear power stations. A brief review is made of the three radiation zones around each site and the selection of Tarapur for Western India, Rawatbhata for Central India and Kalpakkam for Southern India, as sites for nuclear power stations is discussed. (auth)

41095 THE EVALUATION OF POWER-REACTOR SITES. G. D. Bell (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.) and F. R. Charlesworth. p.317-29 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

The method of site evaluation evolved in the United Kingdom is described. The relative hazard to the individual from a release of fission products of a composition believed to be typical of what might be released in reactor accidents is evaluated, and it is shown that the immediately dominant hazard arises from the inhalation of iodine isotopes. For typical inversion conditions, the down-wind concentration following a release may be calculated, and the dose to an individual from inhalation may be estimated. The relative hazard to individuals situated at different distances from the point of release then depends upon the relationship between dose and biological effect. This is not known with certainty. Since, however, large releases may be expected to occur less frequently than small releases and adverse weather conditions giving rise to the longest range hazard are less likely than weather conditions more favorable for dispersion, it is desirable to give greater weight to population closer to the site. This is accomplished by deriving a weighting factor for population which varies with distance as the square of the air concentration. The rating of sites may then be compared by evaluating the sums of the population multiplied by the appropriate weighting factor. In practice, this sum may be obtained by considering population in 30° sectors, divided into areas by arcs drawn at mile intervals. The population in each area is then multiplied by the appropriate weighting factor for that area, and all such products are then summed for that sector. The highest rating for any 30° sector constitutes the site rating for the site. Population within one mile constitutes a special group and is considered separately. A scale of site ratings, based upon United Kingdom population densities, is derived to provide standards for site selection. This rating, however, is not the sole criterion used in arriving at a decision on the safety aspect of siting of a power reactor. A number of other factors influence the judgement, for example, unusual features of population distribution, land utilization, local geography and meteorology, communications, etc. Some examples of these other factors drawn from United Kingdom experience are described. (auth)

41096 SAFETY PRINCIPLES FOR LOW- AND MEDIUM-POWERED RESEARCH REACTORS. G. D. Bell and J. C. Chicken (United Kingdom Atomic Energy Authority, London). p.331-42 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

It is considered that this category of reactor (i.e., up to about 3 Mw) normally exists in universities and research establishments, where free access and a minimum of restriction on use is necessary. Frequently, it is necessary or desirable to site such reactors in urban areas. The various types of reactor that may be used, and a brief statement of the inherent characteristics of the various reactor systems, are given. This is coupled with an indication of the way the various reactors might behave under accident conditions. In order to understand the siting requirements for such reactors, it is necessary to consider the uses to which such a reactor may be put in normal operation. The hazards that could result from fuel loading, and from in-core and out-of-pile experiments, are also considered. The implications of using a reactor as a teaching tool are also discussed. The series of events that could give rise to a release of fission products and the magnitude of the release are examined. The hazard range for various releases is calculated on the assumption that iodine-131 is the controlling isotope and the effect of leak rate on hazard range is examined. From this, standards of housing and siting criteria are derived. Safeguards that can be introduced in the reactor design and operational procedures to eliminate any chance of a hazard occurring are studied. The problems of core, control system, and instrumentation design are discussed, and the desirable features expected in operating procedures are also considered, because ultimately some incidents may only be prevented by administrative safeguards. (auth)

41097 THE ADMINISTRATIVE, LEGAL AND PUBLIC RELATIONS ASPECTS OF NUCLEAR-SITE SELECTION IN THE UNITED KINGDOM. I. G. K. Williams (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.) and L. J. Goff. p.343-54 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

The selection and development of nuclear establishments in the United Kingdom — reactors, processing plants or research centers — has to be reconciled with the legal and regulatory background of an industrialized nation with high population density and intensive land utilization. In site selection particular attention has to be paid to national and local development plans. Site development must take account of legislation designed to preserve public health and safety, to conserve natural resources and to protect amenities and such indigenous industries as agriculture and fisheries. The problems involved are illustrated by reference to recent specific experience, which may also be relevant to developing countries. Each phase of development — site selection, construction, and operation — brings in its train special problems of public confidence. The best safeguard is the development of an informed public opinion, both national and local. The methods employed in the United Kingdom are discussed. (auth)

41098 THE ROLE AND RESPONSIBILITIES OF PUBLIC HEALTH AUTHORITIES IN REGARD TO THE SELECTION OF NUCLEAR-INSTALLATION SITES. S. Halter (Organisation Mondiale de la Sante, Geneva). p.355-62 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In French)

The rapid development of nuclear energy in various forms and ever-extending uses of radioactive substances provide good reasons why public health authorities should have a say when decisions in regard to protection against ionizing radiation are being taken. In the particular matter of selecting sites for reactors, or other nuclear installations, public health participation should be involved in: selecting the actual site; appraising the safety of the proposed undertakings; assessing the efficiency of the safety measures, even under accident conditions; appraising the internal safety checks and the way in which they are organized within the installation; checking the levels of gaseous, liquid or solid effluent disposal as part of environmental surveying in general; deciding what radionuclide concentrations are admissible at various places in and around the site; keeping a check on the total concentrations produced by various sources on a specific site; and deciding what constitute emergency levels in the event of an accident and the public safety measures to be taken. The health authorities should be consulted at as early a stage as possible when decisions are being taken as a result of meteorological, geographic, topographic, hydrological, seismological, and population studies. The various specific hazards must be appraised. Once studies of effluent-disposal questions are completed, the health authorities should be consulted before actual decisions are taken. The fixing of admissible dose and contamination levels under both routine and exceptional or accidental conditions should also come within their terms of reference. Collaboration between the services respectively responsible for nuclear-power development and for health may offer the surest gage of progress. (auth)

41099 SELECTION OF A SITE FOR A NUCLEAR RESEARCH CENTER IN THE NETHERLANDS. M. Bustraan and J. Pelser (Reactor Centrum Nederland, Petten, Netherlands). p.381-90 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

In 1956 a site had to be selected for the research center of the Reactor Centrum Nederland. It was necessary for this site to be such that a high-flux materials testing reactor, a radiochemistry laboratory, a hot metallurgical laboratory, and associated buildings could be operated there without undue hazard to the public. Because of the very high population density and the peculiar hydrological situation in the greater part of the country an elaborate selection method was used to find a suitable place for the center. By eliminating large areas of the country for reasons of population density, about 30 possible sites were found. Other requirements, such as fresh-water supply, accessibility, hydrological conditions, etc., made further elimination possible. Of the remaining few sites, Petten, about 40 km NNW of Amsterdam, was selected as it fulfilled all the requirements set. The site at Petten still seems to be favorable, taking into account criteria developed since the date the choice was made. (auth)

41100 THE LOS ALAMOS SCIENTIFIC LABORATORY — AN ISOLATED NUCLEAR RESEARCH ESTABLISHMENT. N. E. Bradbury (Los Alamos Scientific Lab., N. Mex.). p.391-401 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

A description of the Los Alamos Scientific Laboratory is given from the point of view of its siting, research facilities, and policies for professional personnel. Emphasis is laid upon the necessity of paralleling as closely as possible the attractiveness of location, professional freedom for re-

search, and contact with other scientists and scientific institutions, which are characteristic of academic research institutions of the highest quality. The specific problems of a somewhat geographically-isolated laboratory from the point of view of community facilities and housing for scientific and support personnel are also considered. (auth)

41101 EXPERIENCE IN SITE SELECTION AT THE NATIONAL REACTOR TESTING STATION, UNITED STATES OF AMERICA. J. R. Horan, G. Wehmann, and B. L. Schmalz (U. S. Atomic Energy Commission, Idaho Falls, Idaho). p.403-31 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

The National Reactor Testing Station provides a central location where the United States Atomic Energy Commission can build, test, operate, and evaluate diverse types of reactors, experiments and allied facilities with maximum safety and impunity for all concerned. Over the past 13 yr a total of 29 reactors, 9 critical facilities, and 10 allied installations were sited at this major nuclear establishments. Three major accidents, periodic planned destructive tests, and routine effluent releases demonstrate the suitability of current practices in reactor siting. There was no significant radiation exposure to adjacent facilities or to the offsite population. The desert wasteland proved to be nearly ideal as a suitable physical environment for the retention or dispersal of radioactive effluents. Meteorological and hydrological research, as well as operational experience, resulted in the relaxation of the original conservative criteria for reactor siting. New reactors were built adjacent to existing plants to reduce basic construction costs, as well as to benefit operationally through the use of common maintenance services. Since the start of operations population and agricultural growth have expanded toward the exclusion area of the testing station. A buffer zone has been added, limiting the infringement of other land users. Field experience shows that the diffusion capacity of the atmosphere and the absorptive capacity of the unsaturated zone of the soil are the most important parameters respectively in the application of the sciences of meteorology and hydrology to reactor siting. (auth)

41102 EXPERIENCE IN PLANNING AND SITING NUCLEAR-POWER STATIONS FOR THE CENTRAL ELECTRICITY GENERATING BOARD. F. Faux and G. N. Stone (Central Electricity Generating Board, London). p.435-55 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

The British nuclear-power program was launched in 1955. Two stations, Bradwell (300 Mw) and Berkeley (275 Mw) are now operating. Seven further nuclear stations are under construction or planned for the Central Electricity Generating Board. By 1969 nuclear plant will be contributing over 5000 Mw to the Board's electricity supply system in England and Wales, expected by then to have a total capacity of over 55,000 Mw. The national high-voltage grid, with integrated operation of all power stations, provides favorable conditions for the introduction of nuclear power and individual nuclear or conventional generating units of about 500 Mw capacity can be readily accepted. Nuclear-power stations are currently sited in areas remote from the major coalfields, where coal costs are high, and will progressively supply more of the base load in those areas. Because of relatively high heat rejection rates, all but one of the stations are on estuaries or the sea coast. The choice of site is further limited by a need for acceptable foundation conditions for the heavy loads involved, good construction facilities, etc., and, in addition, the Government's safety-in-siting policy dictates sites relatively remote from population. In the course of site selection a wide range of consultations is necessary and statutory consent procedure is lengthy. Amenity problems are sharpened by remote-siting policy and, in common with conventional stations, special attention is paid to architectural treatment and landscaping. Few adverse environmental effects are so far reported. The problems met in the siting of the Central Electricity Generating Board's nuclear stations and the solutions arrived at are discussed. (auth)

41103 SELECTION OF SITE FOR THE TARAPUR ATOMIC-POWER STATION. M. N. Chakravarti and M. R. Srinivasan (Tarapur Atomic Power Project, India). p.457-65 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

The selection of site for the Tarapur atomic-power station is outlined. In August 1959 the Tarapur Project was set up by the Department of Atomic Energy to implement the first atomic power station to be built in India to feed power into the systems of Maharashtra (around Bombay) and Gujerat. From considerations of cooling, location on the sea coast was necessary. About 200 miles of coastline extending from Bombay to the Gulf of Cambay was examined carefully and the choice was narrowed down to four sites. Detailed hydrographic surveys, exploratory drillings and health-and-safety surveys were carried out at the alternative sites. A study of the availability of construction materials, transportation facilities to site, availability of fresh water, etc., was made. A detailed study of the load demand in the region and the probable dispatch of power was carried out to determine the effect on transmission of power and in particular transmission losses. A careful economic evaluation of locating the atomic power station at the different alternative sites was made taking into account the cost of cooling water-works, foundations and other engineering aspects, transmission losses, and the qualitative factors associated with health and safety. Based on these studies, Tarapur was chosen. (auth)

41104 DATA RELATING TO SELECTION OF SITE FOR THE CHINON POWER STATION. G. Lamiral and A. Combe (Electricité de France, Clamart, France). p.467-76 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In French)

The basic technical criteria for the siting of nuclear-power stations are closely related to those governing conventional thermal stations. On the other hand, the economic criteria directly bound up with the cost of fuel transport are different, because this factor has very little bearing on nuclear power-station siting. The hazard from the nuclear nature of the installations has to be taken into account when selecting the site, but there is some latitude for adapting plant to suit a given site. Data bearing on the choice of site for the Chinon power station, and current French administrative procedure governing the establishment of nuclear-power stations, are outlined. (auth)

41105 FUTURE TRENDS IN SITE SELECTION CRITERIA. Procedures and Practices. p.491-500 of "Siting of Reactors and Nuclear Research Centres." Vienna, International Atomic Energy Agency, 1963. (In English)

Aspects of future siting criteria are discussed on a question-and-answer basis. (T.F.H.)

41106 NEUTRON DOSIMETRY. VOL. II. Proceedings of the Symposium on Neutron Detection, Dosimetry and Standardization Held at Atomic Energy Research Establishment, Harwell, England, 10-14 December 1962. (International Atomic Energy Agency, Vienna). Proceedings Series. July 1963. 618p. (STI/PUB-69(Vol.I)). $13.00; Sch 273,-; 78s-stg; NF 52,-; DM 45,50(IAEA)

Separate abstracts were prepared for twenty-eight of the fifty-one papers on neutron detection, dosimetry, and calibration. The other twenty-three papers were previously abstracted in NSA. (D.C.W.)

41107 NEUTRON DOSIMETRY. R. Beauge (CEN, Fontenay-aux-Roses, France). p.3-9 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In French)

The various neutron dosimetry methods used at the Reactor Protection Research Service for fast, intermediate, and thermal neutrons are described. Activation detectors, chambers, and counters are employed. Some pertinent cross sections and resonance integrals are included. (auth)

41108 THE WORK OF THE EURATOM "DOSIMETRY" WORKING PARTY. P. Delattre and A. Prosdocimi (Euratom, Brussels). p.11-30 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In French)

The dosimetry working group was established to facilitate and provoke interchange of material between European Community countries on the measurement of nuclear radiation in research reactors. Work on the development and testing of measuring techniques for neutrons and gamma radiation is described. (D.C.W.)

41109 DOSIMETRY WORK AT THE SORIN NUCLEAR RESEARCH CENTRE. G. Casarelli, B. Chinaglia, L. Ciuffolotti, et al. (SORIN Centro Ricerche Nucleari, Saluggia, Italy). p.41-54 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

The development, improvement, and testing of chemical, activation, and thermic detectors at the SORIN Nuclear Research Center are described. (D.C.W.)

41110 A NEUTRON rem COUNTER WITH UNIFORM SENSITIVITY FROM 0.025 ev TO 10 Mev. I. O. Andersson and J. Braun (Aktiebolaget Atomenergi, Studsvik, Sweden). p.87-95 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

A neutron monitor that measures the neutron dose rate in rem/hr independently of the energy of the neutrons from 0.025 ev to 10 Mev was developed. The detector is a cylindrical BF_3 proportional counter surrounded by a screen made of polyethylene and boron plastic to give appropriate amounts of moderation and absorption to the impinging neutrons. The sensitivity of the prototype instrument is 18 cps per 2.5 mrem/hr, and it is insensitive to gamma dose rates up to 50 r/hr. The cylindrical geometry makes it difficult to achieve a complete nondirectional response, but that can be obtained by the use of a counter with a spherical screen. A simplified theory is used to obtain the response in the region between thermal and Sb–Be energies where experimental evidence is insufficient. (auth)

41111 THE DETERMINATION OF NEUTRON DOSES FROM SOURCES USED IN THE OIL INDUSTRY. L. Apostol and M. Oncescu (Inst. of Atomic Physics, Bucharest). p.97-108 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

As an aid in measuring the neutron doses resulting from industrial uses of Be–Po neutron sources, a calculation method was developed for finding a relation between the neutron dose and the gamma radiation dose (easily measured by simple dosimeters) measured under certain shielding conditions. Close correspondence of calculated and measured gamma doses verify the method. (D.C.W.)

41112 NEUTRON FLUX DOSIMETRY IN THE BIOLOGICAL HOLE OF THE IRT-1000 REACTOR. Yu. I. Bregadze, B. M. Isaev, B. A. Kvasov, and B. L. Lipis (Inst. of Biophysics, Moscow). p.141-6 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In Russian)

The results of measurement of dose absorbed in various hydrogenous substances upon irradiation in the biological hole of the IRT-1000 research reactor are presented. Measurement of absorbed dose was carried out by tissue-equivalent ionization chambers. Data are quoted to show the distribution along the reactor channel of tissue dose from fast neutrons and gamma rays. (auth)

41113 DOSIMETRY IN A MIXED NEUTRON-GAMMA RADIATION FIELD BY MEANS OF A TISSUE-EQUIVALENT IONIZATION CHAMBER. M. Ladu, M. Pelliccioni, and E. Rotondi (CNEN, Frascati, Italy). p.147-55 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In Italian)

An ionization chamber made of material equivalent to human tissue 0.4-cm thick with a volume of about 300 cc is considered. The equivalence between the mixture of filling gases and the material of the walls is examined. The response of the chamber under irradiation by neutrons as a function of gas pressure and collection voltage is also studied, and the results are compared with those obtained when the chamber is filled with air. (auth)

41114 ACTIVATION DOSIMETRY AND SPECTROMETRY OF FAST NEUTRONS. J. Lamberieux (CEN, Saclay, France). p.157-98 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In French)

Some general characteristics of activation monitors are reviewed. The properties of monitor elements suitable for use in radiological protection are tabulated. The technical characteristics of the monitors used with the Saclay accelerators are then given, together with the counting methods used. The results of measurements carried out with the Saturn synchroton and the 28-Mev linear accelerator are also included. The many advantages of activation dosimetry in high or intermittent neutron fluxes are stressed. The outstanding problem of activation dosimetry lies in the calculation of absorbed dose on the basis of measurement data. It is shown, with the help of an example, that the dose is approximately indicated in terms of the induced radioactivities in a series of monitors. (auth)

41115 THE MEASUREMENT OF STRAY NEUTRONS FROM A LARGE PULSED-PARTICLE ACCELERATOR. K. O'Brien, R. Sanna, and J. McLaughlin (Atomic Energy Commission, New York). p.199-212 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

The problem of determining the stray neutron doses from large pulsed-particle accelerators is discussed, and the equipment and procedures used by the Health and Safety Laboratory to estimate the neutron fluxes and energy spectra from which the neutron doses are derived are described. The results of measurements at the Brookhaven

Synchrotron are presented, and future work is indicated. (D.C.W.)

41116 COMPARISON OF NEUTRON DOSE AND SPECTRUM CALCULATIONS WITH EXPERIMENT FOR FINITE SHIELD SYSTEMS. J. Moteff and H. W. Osgood (General Electric Co., Cincinnati). p.213-25 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

Different shield configurations representing both hydrogenous and non-hydrogenous materials in the form of slabs $3\frac{1}{4}$-ft square and of various thicknesses were tested in the Outside Test Tank Facility. Neutron and gamma dose-rate measurements were made in air for distances ranging from several feet up to about 100 ft away from the surface of the shield slabs. Information on the neutron spectrum within the slab configurations was obtained with the use of threshold foil detectors. The low-energy neutron data were obtained with resonance detectors. The fast-neutron spectrum behind the test assemblies for some of the configurations was also obtained from photographic plate track data. Comparisons of the calculated responses of the threshold foil detectors, based on the predicted neutron spectrum and the known differential cross-sections, are made with the experimental foil responses for various positions within some of the test configurations. The predicted collimated neutron spectrum leaving the slab surface is compared with the measured spectrum that was obtained with the photographic plate track data. Comparisons of the calculated fast-neutron dose rates are made with the respective experimental data obtained in air behind test configurations by means of the conventional one-component and the proposed two-component methods of shield neutron analysis. Fourteen different test configurations containing a hydrogenous material with light and heavy nuclei and 24 test configurations containing a non-hydrogenous material with light and heavy nuclei are used in the comparison. The importance of knowing the angular distribution of neutrons leaving the surface of finite shields for reactor systems to be used for space applications is also discussed. (auth)

41117 PERSONNEL NEUTRON MONITORING AT AB ATOMENERGI. S. Hagsgard and C.-O. Widell (AB Atomenergi, Studsvik, Tystberga, Sweden). p.249-58 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

The processes and problems (latent image fading and gamma fog) associated with personnel monitoring of fast neutrons by counting tracks in an emulsion film packet are described. The foil dosimeter, consisting of a P foil, a Cd-shielded Au foil, and an unshielded Au foil, that is used for higher neutron doses is also described. The energy dependence of the neutron dosimeter is also considered. (D.C.W.)

41118 NEUTRON DOSE MONITORING FOR IRRADIATION OF MATERIALS IN REACTORS. Ragnar Nilsson (AB Atomenergi, Studsvik, Tystberga, Sweden). p.275-92 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

In connection with irradiations of reactor materials, methods that measure high neutron doses ($10^{17} - 10^{21}$ n/cm^2) obtained during long irradiations in a flux varying with time were investigaged. Some experience in the use of Ni, Cu, and Ti as threshold detectors for this purpose is described. This includes determinations of the average cross-section and the effective threshold energy for two reactions, hitherto not usually used: $Cu^{63}(n,\alpha)Co^{60}$, $\overline{\sigma}$ = 0.54 ± 0.07 mb, E_{eff} = 6.7 ± 0.2 Mev; and $Ti^{46}(n,p)Sc^{46}$, $\overline{\sigma}$ = 15 = 2 mb, E_{eff} = 6.0 ± 0.2 Mev. A method of presenting data by introducing a modified fast-neutron fission flux is also given. Results from the three detectors seem to be consistent within 10%. (auth)

41119 ON THE POSSIBLE USE OF THORIUM AS AN INTEGRATING NEUTRON FLUX MONITOR FOR IRRADIATION DAMAGE STUDIES. Ewaryst A. Wojcikiewicz (Central Electricity Generating Board, London). p.305-27 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

A new method for simultaneous measurement of integrated fast- and thermal-neutron fluxes inside power reactors is suggested. The method consists in an irradiation inside a reactor of a thorium foil and subsequent measurement of the build-up of U^{233} and Cs^{137} activity in the foil. Equations are formulated for the rate of the U^{233} and Cs^{137} build-up in terms of thermal-neutron flux, fast-neutron flux and irradiation time. These equations were solved on a Ferranti PEGASUS Computer for a 1-g thorium foil and a range of representative flux values and irradiation times up to 25 yr. The results are presented in a convenient graphical and tabular form enabling a quick estimate to be made of the thermal- and fast-neutron fluxes from the measured quantity of U^{233} and Cs^{137} activity after a known irradiation time. Advantages of the new method over the other commonly used threshold detectors are indicated, and some practical aspects of its feasibility are discussed. (auth)

41120 AN ORGANIC SCINTILLATOR AS A SPECTROMETER FOR NEUTRONS IN THE 0.5 TO 15 Mev RANGE. B. Brunfelter, J. Kockum, and N. Starfelt (Research Inst. of National Defense, Stockholm). p.351-61 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

The different shape of scintillation pulses from γ-rays and neutrons in a stilbene crystal was used to discriminate between the two types of radiation. An electronic circuit based on the space-charge developed at low voltage difference between the last dynode and the anode of a photomultiplier was employed. The spectrometer can discriminate gammas from neutrons down to between 0.5 and 1 Mev neutron energy, depending on the intensity of the γ-ray field. The non-linear relationship between pulse height and recoil-proton energy was determined with the aid of monoenergetic neutrons ranging from 0.6 to 18 Mev. A data reduction program based on differentiation of the pulse-height spectrum was written for the IBM-7090 computer. The spectrometer was tested by measurement of the neutron spectra from a Be–Po and a Pu^{240} spontaneous-fission source. The accuracy of the method is within about 10%. (auth)

41121 A MIXED GAMMA-NEUTRON DOSIMETER. V. I. Ivanov. p.369-76 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In Russian)

The possibilities of measuring the integral dose of mixed gamma-neutron radiation and calculating relative biological effectiveness, using a proportional counter with tissue-equivalent walls, are discussed. The principle that the pulses caused by recoil protons and electrons are channelled along different paths in the electronic circuit is used. The value registered on the output is proportional to the sum of pulse amplitudes; the RBE is calculated electronically. The minimal error conditions are consid-

ered; the sensitivity of the method is evaluated, and practical recommendations are given. (auth)

41122 DOSIMETRY OF NEUTRONS WITH ENERGY BETWEEN 0.5 ev AND 0.5 Mev. O. I. Leipunskii. p.377-84 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In Russian)

The problems of dosimetry of neutrons with energy <0.5 Mev are discussed. It is shown that in practice the dose delivered by neutrons of energy less than 0.5 Mev may be several times greater than the measured dose from fast neutrons. The sensitivity requirements of a dosimeter as a function of neutron energy are considered. It is shown that a promising approach to production of stationary and personnel dosimeters for all neutron energies is represented by the use of a paraffin moderator and measurement of thermal neutrons forming in the paraffin at a certain depth. Other methods of evaluating intermediate-neutron doses are also mentioned. (auth)

41123 RECOMBINATION METHOD FOR DETERMINATION OF LINEAR ENERGY TRANSFER (LET) OF MIXED RADIATION. M. Zel'chinskii. p.397-404 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In Russian)

A method for determination of the radiation hazard of mixed penetrating radiation is considered. By proper filling, the correct conditions are set up in a double tissue-equivalent ionization chamber for ion columnar recombination. It is proved that at specific electrical field intensities in the chamber, the relation of ion currents in the chamber will be a linear RBE function, assuming an RBE dependence on LET in accordance with ICRP recommendations. The linearity condition is required for the determination of the recommended RBE of mixed radiation, independently of its composition and spectrum. The chamber is filled with a propane-butane-air mixture to 4 atm pressure. The conditions for columnar recombination are realized at an absorbed dose rate not exceeding 10 rad/h for a wide range of LET ionizing particles. The accuracy of the recommended RBE determination for mixed penetrating radiation, by means of the proposed method, is of the order of 20%–30%. (auth)

41124 TWO NEW SOURCES OF NEUTRONS. G. Ben-David (Sorek Research Establishment, Rehovoth, Israel). p.407-10 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

The $O^{18}(\alpha,n)$ reaction in water enriched with O^{18} produces neutrons with an average energy of about 2 Mev. Neutron yields/10^6 α particles obtained for $Po^{210}-O^{18}$ and $Th^{228}-O^{18}$ sources are 3 and 1500, respectively. A point alpha source in O^{18} gas can also be used. The delayed neutron emitter N^{17}, prepared by irradiating a Li^6-N^{15} or Li^6-O^{18} compound inside a fast rabbit, can be used to provide a neutron flux with a square-wave appearance. Two monoenergetic neutron groups (1.2 and 0.43 Mev) are provided with negligible gamma flux. Intensities up to 10^8 neutrons/cm^2 can be produced at a 1-Mw reactor power level. (D.C.W.)

41125 NEUTRON COUNTING BY DETECTION OF GAMMA RADIATION FROM DE-EXCITATION OF THE Li^7* NUCLEUS IN THE NUCLEAR REACTION $B^{10}(n,\alpha)Li^7$*. J. Laune (Institut Interuniversitaire des Sciences Nucleaires, Mons, Belg.). p.421-3 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In French)

The detection of the de-excitation gamma ray was proved experimentally to be an acceptable supplementary method for counting neutrons. A detection limit of 30 neutrons/cm^2-s was established. (D.C.W.)

41126 UTILIZATION OF PHYSICAL PROPERTIES OF SOLIDS IN FAST-NEURRON DOSIMETRY. G. Perriot (CEN, Saclay, France). p.433-44 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In French)

The use of the variations in the resistivity of solids subjected to neutron irradiation to determine the corresponding doses is discussed. The design, performance and limits of applicability of a tungsten dosimeter are examined. The isochronous recovery curves of the variation in resistivity for Mo, graphite, and carbon (not graphite) and the variation of the resistivity with temperature show that the carbon is a very promising material. (D.C.W.)

41127 NOMENCLATURE, QUANTITIES AND UNITS IN THE FIELD OF RADIATION MEASUREMENTS INCLUDING FLUX AND SPECTROMETRIC MEASUREMENTS AND DOSIMETRY IN REGARD TO DAMAGE STUDIES, RADIOCHEMISTRY, RADIOBIOLOGY, etc. J. W. Boag (Mount Vernon Hospital, Northwood, Middx, Eng.). p.445-9 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

Problems in the development of suitable nomenclature and quantities are outlined; and the bases, accuracy, and derivation of certain quantities recently introduced or proposed by the International Commission on Radiological Units and Measurements. The units associated with these quantities are also considered. (D.C.W.)

41128 ADAPTATION OF THE CALVET MICROCALORIMETER FOR REACTOR DOSIMETRY. E. Calvet (CNRS, Marseille), J. Chatelet, J.-R. Puig, and A. Romano. p.465-76 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In French)

The principle of the Calvet conduction microcalorimeter, consisting basically in the measurement of not a temperature difference but the heat flux passing through a thermal conduction device, was applied to reactor dosimetry. The prototypes designed and tested comprised two thermopiles in an aluminium alloy casing 20 mm in diameter and 50 mm long, the sensitive elements being two cores that absorb nuclear radiation. One lead and one graphite core were used; others are also possible. To permit calibration, the cores had electric resistances of known value. The equipment was designed to remain indefinitely in very high gamma-ray and fast-neutron fluxes, and the greatest care was devoted to the solution of the electrical insulation problems involved under these conditions. The technical construction of the prototypes is described, and the results are given. (auth)

41129 NEUTRON DETECTION WITH AN ABSOLUTE FISSION COUNTER. Frederick S. Kirn (Argonne National Lab., Idaho Falls, Idaho). p.497-512 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

The requirements, construction techniques, performance, and uses of absolute fission counters are discussed; the performances of several counters are compared. An absolute fission counter with the basic design of a parallel-plate ionization chamber has given an efficiency >99%. Variations on the basic design and their applications are also described. (D.C.W.)

41130 THE CENTRAL ELECTRICITY GENERATING BOARD DOSEMETER CALIBRATION FACILITY. K. F.

Orton (Central Electricity Generating Board, Berkeley, Gloucestershire, Eng.). p.529-35 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

The instruments used to measure gamma dose rates and neutron fluxes at British civilian nuclear power stations are described, and progress on ideal instruments is discussed. The facility established for the calibration of radiation survey instruments is described, and problems associated with the calibration program are outlined. (D.C.W.)

41131 THE USE OF THE NEUTRON FLUX FROM THE THERMAL COLUMN OF THE WWR-C REACTOR AS A CALIBRATION FLUX. S. Pshona and K. Zharnovetskn. p.537-44 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In Russian)

The use of the slow-neutron flux at the outlet of the vertical channel of the reactor's thermal column as a calibrating flux is proposed. The advantages are outlined, and the results of the investigation of changes in the neutron flux with time are given. The accuracy of the flux values is determined. The slow-neutron flux from the vertical channel of the thermal column of the WWR-C reactor is used in the Swierk Nuclear Research Centre (Poland) for calibration of measuring and dosimetric equipment. The accuracy of calibration so obtained is fully adequate to the requirements. (auth)

41132 STANDARDIZATION OF FISSION NEUTRON SOURCES. Sh. Deme and I. Fekher. p.557-65 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In Russian)

A simple method for standardizing fission neutron sources, based on the principle of counting the accompanying particles, is presented. (auth)

41133 STANDARDIZATION OF A SPONTANEOUS-FISSION NEUTRON SOURCE. P. Fieldhouse and E. R. Culliford (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.565-80 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

A spontaneous-fission neutron source consisting of a sphere containing 24% Pu^{240}, and its calibration by comparison of its output with that from a monitored T(d,n)He^4 source of 14-Mev neutrons, is described. An accuracy within 1% seems attainable by this method. The yields from this source are compared with those of other sources. (D.C.W.)

41134 ENERGY SPECTRA OF NEUTRONS FROM STANDARD SOURCES. Antonino Rubbino (Universita, Catania, Italy). p.595-8 of "Neutron Dosimetry. Vol. II." Vienna, International Atomic Energy Agency, 1963. (In English)

The neutron energy spectra from Po–Be and Pu–Be sources have been measured with satisfactory results during the last few years, using the technique of recoil-proton tracks in photoemulsion. A new neutron detection technique capable of producing more rapidly the same kind of information is described. The preliminary results reported, obtained in a very short time, are in satisfactory agreement with results of work described in the literature. (auth)

41135 BACKGROUND RADIOACTIVITY MONITORING OF A PILOT STUDY COMMUNITY IN WASHINGTON COUNTY, MARYLAND. Cecil Pinkerton, William Y. Chen, R. G. Hutchins, and Ralph E. Schrohenloher (Robert A. Taft Sanitary Engineering Center, Cincinnati). 67p. (CONF-16-14)

From International Symposium on the Natural Radiation Environment, Houston, Tex., Apr. 1963.

Aerial radiometric measurements could be related to ground dose and tenor of radioactive minerals when measurements were made over large uniform areas, as indicated by soil type, southwest of Sharpsburg. As shown by intensive investigation of the background radioactivity at specially selected study houses in Sharpsburg, Md., differences of up to 4X γ radioactivity and alpha radiation may be indicated by sampling of basement soil at some locations having little variation in aerial radiometric or ground dose values. The aerial radiometric data are useful for evaluating health data in areas of Washington County where soil material is uniform and free of rocky conditions. It seemed that enough handborne measurements to characterize lithological units from a detailed geological study and soil types as mapped in the typical soils survey offer an alternative to use of gross aerial radiometric data. There seemed little doubt that the mass radiation exposure effect in Sharpsburg is greater than in rural areas; this is not however, necessarily due to gamma radiation. Potential alpha sources exist in outcropping geological strata, and as a result, residents are living near soil or rock that exhibit a fourfold difference in alpha activity from place to place. A somewhat uniform gamma dose results from different ratios of gamma-emitting radionuclides in the environment of the study community from place to place. Small, but detectable differences in dose rate under otherwise uniform conditions are probably epidemiologically more significant than larger differences under nonuniform conditions. An increased dose rate was recorded in a basement with walls and floor of natural soil and rock. (auth)

41136 NOSE SWABS AND URINALYSIS AS INDICATORS OF EXPOSURE TO I-131. R. C. Barrall (Illinois Inst. of Tech., Chicago). 8p. (CONF-67-31)

From Health Physics Society 8th Annual Meeting, New York, June 1963.

During a maintenance operation on the Armour Research Reactor, a heat lamp, which was drying a valve, caused a small quantity of I^{131} to become airborne. A continuous air monitor sampling in the area gave the alarm and the area was immediately evacuated. I^{131} was quickly identified by the use of a 256 channel analyzer. Nose swabs of the personnel involved were taken and 24 hour urine samples were obtained. A single channel analyzer was set up, calibrated for I^{131} and thyroid counts were started several hours after the incident. The thyroid count rose during the first 24 hour period and then declined closely following the 8 day half life of I^{131}. The urine samples were analyzed by two different gamma counting techniques. Portions of the 24 hour urine sample were also sent to a commercial urinalysis service and analysis for I^{131} specifically requested. The results of the commercial service in this instance appeared to be poor. Nose swabs taken immediately after the incident were analyzed using a NaI well crystal. The average value of the ratio μc on nose swabs to μc in thyroid was found to be 2.6×10^{-2} with all values within a factor of 6. The average value of the ratio μc in 24 hour urine sample to μc in thyroid was 5.7 with all values within a factor of 2. It would appear that at short times after a suspected exposure to I^{131}, nose swabs and urine samples are both useful in making a rapid assessment of exposure. The data presented are based on 10 subjects. (auth)

41137 ENVIRONMENTAL MONITORING IN THE VICINITY OF URANIUM MILLS. E. C. Tsivoglou, and C. E. Sponagle (Robert A. Taft Sanitary Engineering Center, Cincinnati). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/45, 26p. (CONF-104-33)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The extensive experience of the Public Health Service in monitoring the environment near American U mills and the highly successful pollution control program that has resulted are described. Environmental contamination from mills involved primarily the water environment, and monitoring was mainly for Ra^{226}, with determination of U and Sr^{90} as desirable. A Ra^{226} surveillance network covering 7 states and 11 mills was recently established to assure continued protection. Monitoring included river sediments, aquatic biota (insects, algae, fish), water, mill effluents, and crops and topsoils from farms irrigated with contaminated river water. Spent ore solids, or tailings, proved to be the most important source of environmental contamination by mill wastes. In the Animas River, for example, 95% of the dissolved Ra^{226} in the downstream river water resulted from leaching of river bed deposits of tailings, rather than from direct mill discharges of Ra^{226} in the dissolved state. Improved procedures for capturing and retaining the tailings at the mill yielded immediate sharp reduction of downstream dissolved Ra^{226}. The river sediments proved to be an excellent indicator of mill pollution. Routine surveillance of their gross α and/or Ra^{226} content is a reliable indicator of accidental spills of mill wastes. Ra^{226} concentration factors for aquatic biota were determined, and aquatic populations were used as a reliable indicator of the presence of chemically toxic mill wastes such as organic raffinate. Ra^{226} uptake from polluted irrigation water by various crops was measured and showed that feed crops such as alfalfa can become highly contaminated. A high degree of protection of the waters of the Colorado Basin was achieved. Earlier dissolved Ra^{226} concentrations ranged as high as 88 $\mu\mu$g/l, whereas presently these streams contain less than 1.0 $\mu\mu$g/l. (M.P.G.)

41138 POLONIUM IN THE URINE OF MINERS AS A MEASURE OF EXPOSURE TO RADON. D. Djurić, D. Panov, M. Kilibarda, L. Novak, and M. Vukotić (Inst. of Occupational Health, Belgrade). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/60, 14p. (CONF-104-41)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

By periodic measurements in the U mine in Yugoslavia, concentration of Rn in the air has been established in the range of 1.6×10^{-11} to 3.38×10^{-9} C/l. It was of interest to establish the ratio of Po^{210} excretion in the urine of miners to the Rn exposure. Po was studied in the urine of 243 miners employed from some months to 10 years in the U mine. Concentrations of Po^{210}, varying from 0 to 2.5 picocuries/l, were measured. Concentrations of Po in the urine were theoretically calculated, taking into consideration Rn daughters deposited in the lungs as only one source of Po. It was established that Ra body burden would contribute a negligible amount of Po in the urine. Statistical analysis was made of Po in the urine of 30 miners employed for ~1 year and 30 employed for ~5 years. It could be concluded that the level of Po in the urine was not influenced by duration of employment in the U mine only. It is considered that 50% of Po in the urine of miners is originated from Rn daughters in the lungs and 50% from Rn accumulated in the body fat. Assuming this, we are able to estimate approximate integral exposure to Rn, using our findings of Po in the urine. We established that about 40% of our miners are exposed to the concentration of Rn below MPC and about 60% to concentrations between 1 to 5 MPC. (auth)

41139 RADIOLOGICAL HEALTH AND SAFETY IN THE URANIUM MINE IN JAPAN. H. Misawa (Atomic Fuel Corp., Tokyo). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/2, 19p. (CONF-104-4)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Uranium ore has been mined by tunnel at Ningyo-toge and Togo mines for the past 7 years. The external exposure dose of the miners is measured by a film badge. Periodic medical examinations are given. The dilution and removal of Rn and its daughters by ventilation is one of the best ways to minimize the inhaled amount. The utmost efforts are made to keep the concentration of Rn under the level of 2.5×10^{-7} μC/cc by mechanical ventilation. In spite of the present best mechanical ventilation, it is difficult to maintain the Rn-concentration level below the recommended level of 10^{-8} μC/cc. The Rn level is reduced locally by water spray and Rn absorbents. A dust respirator is used to prevent inhaling Rn and its daughters directly. Dust conditions are measured precisely twice a year at every working place. The concentration of dust in the pit air averages 2 to 3 mg/m^3, and the level of the concentration of U in pit air is about $^1/_{100}$ of the maximum permissible recommended concentration. The results of a survey of river water near the pit mouth are presented. No danger to radiological health and safety was found. (M.P.G.)

41140 MONITORING OF RADIOACTIVE CONTAMINATION OF AGRICULTURAL AREAS AROUND NUCLEAR MINING INSTALLATIONS. MILK PROBLEM. G. Michon (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/24, 7p. (CONF-104-22). (In French)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Ra is the most toxic of all the naturally occurring radionuclides that may be released and dispersed into the environment during the extraction and processing of radioactive ores. As an alkaline earth element, Ra is liable to be metabolized by plants and animals and to reach man by contamination both of water and of certain foods. Of these, milk is an important carrier in the area surrounding some French mines. A scheme for the monitoring of milk in the area of U mines and ore processing plants is suggested. The technique used for Ra determination is described, and some conclusions are drawn from the data obtained on the health-protection value of such monitoring. (auth)

41141 MONITORING IN FRENCH URANIUM MINES. F. Duhamel, M. Beulaygue, and J. Pradel (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/22, 16p. (CONF-104-20). (In French)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

In every mining division a team of trained operators has

been set up to monitor the external and internal exposure of each mine worker. The functions of these monitoring teams and their relation to the operational services are described, and the results obtained are appended. (auth)

41142 GENERAL RADIOLOGICAL HEALTH AND SAFETY CONDITIONS AT A URANIUM ORE PROCESSING PLANT. J.-L. Saconney (Société Industrielle des Minerais de L'ouest, Paris). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/19, 9p. (CONF-104-18). (In French)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

A U-ore processing plant such as that at l'Ecarpière receives ores with about 1000 ppm U and delivers to the refineries magnesium uranate containing 60 to 65% metal. The release of small quantities of Rn causes a minor safety problem in the part of the plant where the ore is prepared, crushed, milled, and chemically attacked. The production and packing of the dried uranate calls for strict safety measures, due to the risk of workers inhaling or ingesting active dust. The safety measures taken are supplemented by medical checks, consisting mainly of surveillance of U excretion in the urine. No serious radiological problems are associated with the disposal of the sterile gangue. (auth)

41143 PROTECTION OF WORKERS AGAINST RADIOACTIVE GASES AND DUSTS IN FRENCH URANIUM MINES. M. Avril and J. Pradel (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/17, 13p. (CONF-104-17). (In French)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

French U miners are protected in various ways against radioactive gases and dusts. By the use of appropriate operating methods, hermetic sealing of unused galleries, elimination of infiltrating water, provision of powerful ventilation, and application of the customary dust-prevention techniques, it has generally been possible to reduce Rn and dust concentrations to below maximum permissible levels. Attempts to introduce personal protective measures have been made but have always been handicapped by considerable practical difficulties. Examples of ways in which improvements in working conditions can be achieved are quoted. (auth)

41144 LONG-LIVED RADIOACTIVE DUST MEASUREMENTS. M. Gouix and M. Pradel (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/16, 24p. (CONF-104-16)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The radioactive dust in suspension in the air in U mines has a long half life and must be monitored in the various workings. Samples are taken by means of equipment that has a compressed air pump worked from the main air supply or from bottles of compressed air at a pressure of 200 kg. The measurements are made by α counting with a zinc-sulfide scintillation counter. The method is compared with U monitoring by fluorimetry. (auth)

41145 EXPERIENCE IN THE CONTROL OF RADIATION AT A SMALL THORIUM MINE IN SOUTH AFRICA. R. S. J. du Toit (Dept. of Mines, Johannesburg). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/11, 13p. (CONF-104-12)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The radiation hazards at a small Th mine are dealt with. The recorded γ-ray intensities and α activities are summarized. The results of film badge surveys are given, and the control measures are stated. (auth)

41146 EXPERIENCE IN THE MEASUREMENT OF RADON AND RADON DAUGHTER CONCENTRATIONS IN THE URANIUM MINES OF SOUTH AFRICA. R. S. J. du Toit, S. R. Rabson, and C. J. Verwey (Dept. of Mines, Johannesburg). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/10, 21p. (CONF-104-11)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

A description is given of the methods and techniques used in a survey of the Rn and Rn-daughter concentrations in the U mines of South Africa. The nature of the mines and the methods of ventilation are briefly described. An outline is given of the Rn and Rn-daughter concentrations obtained and their variation along the ventilation circuits. The working pattern of the mine workers is dealt with, and the significance of the Rn and Rn-daughter concentrations existing in the mines is discussed. (auth)

41147 CONTAMINATION OF RUNNING WATER WASTES DURING URANIUM ORE MILLING. D. Gvozdanović (Inst. of Occupational Health, Belgrade). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/59, 10p. (CONF-104-40)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The Department of Radiation Protection of the Institute for Occupational Health is controlling a little river, on whose bank a U mine and processing plant are situated. The control was performed when waste waters from the mine and processing were put directly into the river after building a little dam for collection. Total β and α activity is measured in the two fractions of dissolved and suspended pollution in the river water. A comparison is made between the results obtained before and after collection of waste water. The results indicate that contamination might be too high even after sedimentation behind the dam. (M.P.G.)

41148 INCREASE IN LUNG CONTAMINATION AS A RESULT OF INHALING RADON IN A DUST-LADEN ATMOSPHERE. J. Lafuma and M. Medjedović (Inst. of Occupational Health, Belgrade). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/58, 9p. (CONF-104-39)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The lung radioactivity of rats inhaling dust-free Rn was measured. The same radioactivity in rats breathing Rn mixed with dust was then measured, and at the same time the irradiation sources in the lung were identified by γ spectrography. The breathing of air containing dust in addition to Rn results in greater contamination, owing to inhalation of a larger quantity of the short-lived active deposit, whose α-emitting components have a considerable biological effectiveness. Although the Rn daughter products from RaA to RaC'' have a short half life, they constitute a considerable source of contamination under mine conditions.

Therefore, when evaluating the irradiation hazard in U mines, it is not sufficient to measure the exposure to Rn and long-lived dusts only; the dose from the short-lived active deposit must also be measured. (M.P.G.)

41149 DOSE DISTRIBUTION RECEIVED ON INHALATION OF RADON-222 AND ITS DECAY PRODUCTS. E. Pohl (Univ. of Innsbruck and Research Inst. of Gastein, Austrian Academy of Science). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/56, 23p. (CONF-104-38)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

It is incorrect to calculate the radiation dose from Rn inhalation solely on the basis of the amount of Rn taken in. The air breathed in always contains short-lived daughters of Rn, which are filtered out in the respiratory system. This leads not only to a high concentration of decay products in the respiratory system, but also to the decay products being transmitted throughout the organism through the bloodstream. The concentrations of RaC, or of RaB + RaC, were studied in human blood and urine and in various organs of mice and guinea pigs after inhalation of Rn lasting for several hours. The RaB:RaC ratio in the organs at the end of radiation could be determined by analyzing the decay curves for the individual specimens. In every case, the concentrations of RaB and RaC were found to exceed the equilibrium values with respect to the amount of Rn taken in. Results are presented. The decay products were detected by measuring the γ-radiation from RaC or RaB + RaC. The decisive factor indicating the dose level is the RaC content. Since the RaC content of an organ cannot be measured directly in human beings, it is impossible to calculate the exact dose level of the subject on inhalation of Rn. However, the high RaC content of the blood shows that calculations based on the quantity of Rn incorporated furnish values that are far too small, even when the respiratory system is excluded. (M.P.G.)

41150 MORTALITY PATTERNS AMONG UNITED STATES URANIUM MINERS AND MILLERS, 1950 THROUGH 1962. J. K. Wagoner, V. E. Archer, B. E. Carroll, D. A. Holaday, and P. A. Lawrence (National Cancer Inst., Bethesda, Md.). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/43, 20p. (CONF-104-31)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

To assess the potential hazards to man from internal radiation emitters, a study of the mortality experience among U. S. uranium miners and mill workers was initiated in 1950. By 1958, 3306 miners had volunteered for at least one physical examination by the study team and had provided social and occupational data in sufficient detail to permit follow-up study of their health status. An analysis of mortality through 1959 was made by the modified life table technique. Among white miners 6 respiratory cancers were observed as compared with 2.2 expected, and 89 deaths from all causes occurred as compared with 78.4 expected. A new analysis based upon follow-up through 1962 is presented, which permits a current assessment of health hazards among U miners and mill workers. The new and expanded data will permit an examination of the causes of death in greater detail. Analysis is being made of the time elapsed since first underground employment in an effort to obtain a rough approximation of the latent period between the initial exposure and the onset of cancer. It is important to determine the role of other mining exposures before attributing unusual mortality experience entirely to radiation. It is also of importance to evaluate the interaction of latency and dosage in relation to cancer mortality. These two approaches are at present under investigation at the National Cancer Institute. (M.P.G.)

41151 RADIOLOGICAL HEALTH AND SAFETY IN THE AUSTRALIAN URANIUM MINING AND MILLING INDUSTRY. J. R. Stewart (Australian Atomic Energy Commission, Coogee, New South Wales). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/65, 8p. (CONF-104-48)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Uranium mining and milling operations have been carried out in 4 main areas in Australia. When the industry commenced in Australia, a code of practice was introduced to cover mining, treatment, and handling of U ores and concentrates. The standards adopted were based on those laid down by the International Commission on Radiological Protection. A synopsis of results of radiation and Rn testing in the Australian mines is given. As would be expected, occasional health problems have arisen in the mines containing very high grade ores but, in general, the internationally recommended levels have not been exceeded. Good housekeeping and the wearing of respirators in the product packing rooms ensure that no undue health hazards arise in the chemical treatment plants. A summary of sampling procedures and results is given. (auth)

41152 ESTIMATION OF EXTERNAL EXPOSURE TO RADIATION AND INTERNAL CONTAMINATION OF WORKERS IN FRENCH URANIUM MINES. D. Mechali and J. Pradel (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/26, 8p. (CONF-104-24). (In French)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Workers in U mines are subjected to the risks of external exposure to radiation and of internal contamination through respiration. Evaluation of these 2 forms of contamination will indicate whether safety standards are being observed. External irradiation is determined by means of individual film badges. Internal contamination is evaluated indirectly from measurements of atmospheric contamination and of the length of time spent in the various working areas. By these means, it is possible to check observance of permissible exposure levels for the whole body, and for the respiratory system. (auth)

41153 METHODOLOGY OF MONITORING URANIUM ENVIRONMENTAL EXPOSURES. J. C. Gilliland and R. F. Bell (Univ. of Colorado, Denver). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/35, 16p. (CONF-104-29)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Environmental sampling procedures for a radiation-protection program for U mills are outlined. Dose is most conveniently calculated from the environment from an average weighted exposure index. It is necessary, therefore, to define each distinctive similar exposure concentration peculiar to each plant work area and determine the length of time each worker spends in each of these distinct environments. A good estimate of average weighted exposure based on job classification can often be made where

the job classification requires a similar time work flow of the workers through job exposures. Sampling frequency of each significantly different exposure in a plant can be decided from the distribution of sample values found in the environment, the worker time in the environment, and desired accuracy of the evaluation. Examples are shown of operative sampling programs and data recording. There is some disparity between U exposure found on chemical analysis and the presently suggested methods of calculating these exposures from gross α determinations. Comparative empirical data using both methods at operating mills are given, showing that U calculations from gross α counting give U values twice as high as actually found by spectrophotometric determinations. (M.P.G.)

41154 MONITORING OF THE RADIOACTIVITY OF WATER IN THE AREA OF URANIUM MINES AND PROCESSING PLANTS. P. Bovard and J. Pradel (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/23, 11p. (CONF-104-21)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Effluents from U mines and processing plants contain radioactive elements such as U and Ra-226. These effluents, after appropriate processing, are released into neighboring water-courses. A monitoring system comprising permanent sampling stations has therefore been set up. Following a general study on water utilization, measurements of the activity of the flora, fauna, and sediments in the catchment area are made at intervals. The methods of measurement are briefly described. (auth)

41155 STUDY OF INDUSTRIAL HYGIENE IN THE ANDUJAR URANIUM PLANT. E. Iranzo (Junta de Energía Nuclear, Madrid). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/7, 112p. (CONF-104-9) (In Spanish)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

A brief account is given of the process used in the Andújar U processing plant. The various hazards to which workers at the plant may be exposed are indicated, and the methods of evaluation of these hazards are described. The values thus obtained and the steps taken to protect both equipment and staff have served to reduce to a minimum the potential hazards to which the latter are exposed. The studies carried out deal with: radioactive contamination of the workplaces where the dry ore and the U concentrates are handled; determination of internal contamination of staff by means of U-excretion tests; determination of the external radiation dose to which staff are exposed in each area of the plant, and the amount of the dose received; determination of the concentration of dust in the environment; and concentration of radioactive elements in effluents in different phases of the process, before and after decontamination. (M.P.G.)

41156 TRIAL APPLICATION OF HUMAN GAMMA-SPECTROMETRY FOR MONITORING OF CONTAMINATION AFFECTING MINERS. L. Jeanmaire and J. Chameaud (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/27, 10p. (CONF-104-50). (In French)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

A brief description of the mobile facility, which has been used in a mining division at Razè, is followed by a statement of the methods of measurement applied, of the difficulties encountered, and of the conclusions drawn from a series of ~40 measurements. (auth)

41157 THE EVOLUTION OF HEALTH STANDARDS AND OF METHODS OF THEIR ENFORCEMENT IN AUSTRALIAN URANIUM MINING AND MILLING. G. F. Mead (Bureau of Mineral Resources, Canberra City, Australia). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/66, 22p. (CONF-104-49)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The changes in health standards between 1950, the commencement of U mining in Australia, and 1957, when agreement on satisfactory standards was reached, are discussed. The changes made were partly due to local experience and partly to investigations of practice in other countries. Methods of testing working places for radioactivity and means used for enforcement of the standard are also discussed. (auth)

41158 REVIEW OF MEDICAL FINDINGS IN THE ROUTINE CLINICAL EXAMINATION OF URANIUM WORKERS. C. C. Freed (Chamber of Mines Hospital, Johannesburg). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/53, 13p. (CONF-104-36)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The medical findings in workmen employed in U reduction plants and a calcining plant are discussed. A 10-year period is covered. Workmen are subjected to an annual medical examination, which includes x-ray examination of the chest and paranasal sinuses and urinalysis for U excretion. Regular dust and radiation surveys are controlled by a health physics team. The results of these surveys show dust concentrations well within the MPC levels and radiation exposure well within maximum permissible levels. The urine U levels indicate minimal absorption and, in general, the laboratory figures are in keeping with the absence of any disease or injury in the workmen which could be attributed to occupational exposure. Emphasis is placed on the importance of maintaining medical records of workmen occupationally exposed and of continued observation and statistical evaluation of medical records. (auth)

41159 AIR MONITORING DURING URANIUM-STEEL FABRICATION PROCESSES. G. G. Eichholz (Dept. of Mines and Technical Surveys, Ottawa). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/1, 20p. (CONF-104-3)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

U concentrations in air were monitored during pilot-plant and full-scale operations involving the casting, rolling, scarfing, and grinding of U-containing steel billets, containing up to 0.5% U. Portable air samplers were used employing felt filters. The U collected was determined by counting under an end-window Geiger counter, after allowing for decay of the Rn daughters, and by fluorimetric chemical analysis in cases of particular interest. The tests confirmed that no hazardous concentration of U will be encountered during casting and rolling in a well-ventilated plant. Scarfing and grinding operations, however,

require strong local ventilation and the wearing of face masks by the immediate operator concerned. (auth)

41160 DUST CONDITIONS IN THE URANIUM EXTRACTION PLANTS OF SOUTH AFRICA, WITH SPECIAL REFERENCE TO THE RESULTS OF URINALYSIS. S. R. Rabson (Dept. of Mines, Johannesburg). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/12, 21p. (CONF-104-13)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

U is extracted from the siliceous pulp after Au extraction by a process of acid leaching followed by ion exchange. The final product is in the form of a slurry of U oxide. A "Code of Practice" is in force to ensure safe operating conditions. The sampling procedures for siliceous dust, U oxide dust, and other contaminants are described, and results are given to indicate the prevailing conditions. U dust concentrations are negligible except at the final filtration section of the U oxide slurry, where concentrations of U up to 50 $\mu g/m^3$ can be found, with an occasional result up to ~100 $\mu g/m^3$. A program of monthly urinary examinations is carried out for all personnel working in processes which involve U-bearing material. Summaries are given of the results of the urinalyses for operators in the various work categories. The number of results over 0.05 μg U/ml is low, and such cases occur only at the final filtration and handling of the slurry. These occurrences are considered to be due to ingestion into the system as a result of body and clothing contamination rather than due to inhalation. (auth)

41161 MEASUREMENTS OF RADIOACTIVE GAS AND DUST AS WELL AS INVESTIGATIONS OF THEIR PREVENTION IN JAPANESE URANIUM MINES. N. Fusamura (Weseda Univ., Tokyo) and H. Misawa. Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/4, 33p. (CONF-104-6)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Periodic measurements of radioactive gas and dust in mine air were carried out at 2 representative U mines in Japan. Rn concentration in the mines was determined by using an ionization chamber and a transistorized vibrating reed electrometer and was found to vary from 15.0 to 0.5×10^{-7} μC/cc. A close relation between the exposure dose rate on the mine gallery surface and the Rn emission from the ore deposit was found. The relation is useful for the determination of the necessary amount of air flow to reduce the Rn concentration to a required level. To remove Rn, adsorption of Rn with active C was tried. Keeping Rn concentration to the order of 10^{-8} μC/cc by mechanical ventilation was also investigated. Rn decay product concentrations were measured by determining the α activity of a high-efficiency asbestos cellulose filter, through which known volumes of mine air were drawn. Airborne radioactive-dust concentrations were measured by weighing the filter paper, through which known volumes of mine air were sucked. The U concentrations in collected dust are determined as U_3O_8 by means of the fluorescence method. The U contents in dust and its concentrations in mine air, which are in general 0.08 to 0.01% U_3O_8 and 45.0 to 1.0×10^{-13} μC/cc respectively, change in close contact with the grade of ore in deposit and the variety of working conditions. The concentrations of dust particles and the size distributions of airborne dust were also measured. Most of the particles are under 1 μ, and the particle concentrations are therefore relatively higher compared with the gravimetric concentrations. Wet drilling is carried out for dust prevention. For personal protection, dust masks with high efficiency synthetic fiber filters were adopted. (M.P.G.)

41162 RADIATION HAZARD SURVEILLANCE IN SPANISH URANIUM MINES. E. Iranzo and J. Llarte (Junta de Energia Nuclear, Madrid). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/8, 68p. (CONF-104-10)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Since 1957, in Spanish U mines the concentrations of the daughter elements of Rn have been systematically measured, external radiation doses have been monitored, U in urine has been analyzed, and the concentration of radioactive elements, other than Rn and its daughter elements, in dust from ore has been determined. The results obtained up to February 1963 are presented. An explanation is given of the procedures laid down in the Atomic Energy Board's safety standards for its mines, based on the values derived from measurement of radiation levels and concentrations of radioactive aerosols. The maximum value found for the concentration of the daughter elements of Rn in an unventilated area was 857 times higher than the MPC. The concentration of each of the daughter elements of Rn was determined in a number of cases for the purpose of studying their equilibrium ratios. The monitoring of external radiation was limited to areas where γ-radiation levels were high enough to give grounds for fearing that they might attain values higher than the maximum permissible doses. So far no Spanish miners have been found to be suffering from any illness or disorder which could be attributed to radioactivity. (M.P.G.)

41163 ON THE LEVEL OF POLONIUM IN URINE OF JAPANESE URANIUM MINERS. T. Inoue, Y. Yamada, and S. Akiyama (Musashi Inst. of Tech., Kawasaki City, Japan). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/6, 7p. (CONF-104-8)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Evaluation of Po in urine samples is a common bioassay method for those inhaling Rn. Po^{210} was surveyed in the urine of people belonging to the following groups: miners and mining engineers working in U mines of Ningyo-toge district; inhabitants living near hot and cold springs containing high concentration of Rn; Ra dial painters; and research workers and students. The urinalysis method developed and employed is as follows: took 100 ml urine sample; modulated pH of sample nearly to 0 with 20 ml of 6N HCl; deposited sample electrochemically on a Ni plate at 50°C during 60 min (recovery rate is 50%); and counted α-disintegrations on each side of plate with low background 2π gas-flow counter or α-scintillation counter (maximum detectable sensitivity is 10^{-15} g of Po^{210}). The sensitivity was improved with a condensing method adopting co-sedimentation with 6N NaOH. Po^{210} was detected in 2 urine samples of the 20 samples taken from miners, and in 1 sample of the 10 taken from Ra dial painters. (auth)

41164 PRACTICAL MEDICAL EXAMINATIONS OF FRENCH URANIUM MINERS. J. Chameaud (Commissariat à l'Energie Atomique, Paris). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/25, 9p. (CONF-104-23). (In French)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Uranium miners in France have been under medical supervision since the mines were first worked in 1947. Chest x rays, hemograms, and general clinical examinations were carried out upon recruitment of workers and at intervals subsequently. In 1957, highly detailed official recommendations were issued concerning fitness conditions and medical and hematological examinations for workers exposed to radioactive hazards. In the case of miners, similar recommendations were made to the medical staff responsible for prophylaxis of silicosis. They impose a certain minimum level of medical supervision, but any test and examination likely to contribute to the prevention of illness may be carried out. In the mines today, where the system of protection against radioactive gases and dust is very efficient, it is regarded as unnecessary to prescribe the regular conduct of tests, the results of which are mostly negative. This system of protection has resulted in an atmosphere, peculiar to U mines, which encourages infections of the upper air passages and bronchial tubes and increases the incidence of rheumatism. For this reason, clinical examination of workers upon recruitment and periodically during service remains essential. It seems likely that silicosis remains the most serious hazard and that health services should operate with this in view. (auth)

41165 SAFETY REGULATIONS IN URANIUM MINES. M. Dousset (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/28, 10p. (CONF-104-25). (In French)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The principle radioactive hazards in mines are due to the γ radiation of the ores, Rn and its daughter products, and long-lived radioactive dusts. The regulations should make provision for a safety organization applying various measures, such as ventilation of underground workings, sealing-off of old workings, wet drilling, waiting periods before return to workings after blasting, and the use, in certain cases, of individual safety apparatus. The regulations should make provision for area and personal monitoring. Area monitoring should consist of measurement of the concentration of Rn and its daughter products in the atmosphere, and measurement of the concentration of long-lived radioactive dusts in the atmosphere. The methods and frequency of sampling and measurements should be specified. Personal monitoring should be based on use of personal dosimeters for measuring external irradiation and, where possible, the application of direct and indirect methods to determine internal contamination. The regulations should provide for medical selection and supervision of personnel. (auth)

41166 MEDICAL CONSIDERATIONS FOR EMPLOYMENT OF WORKERS IN URANIUM MINES AND MILLS. R. F. Bell and J. C. Gilliland (Univ. of Colorado, Denver). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/36, 17p. (CONF-104-30)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Preplacement medical examinations are performed to protect the health of potential employees and to minimize future unjustified employer liability. The recommended specific medical preemployment criteria are given in detail. It must be recognized by the medical examiner that, in addition to the usual exposures, U workers are uniquely exposed to radioactive dusts, external radiation, U, and V. Unfortunately, the implied chronic diseases these unique exposures may cause in a given individual cannot be clinically differentiated from ordinary diseases of life or from other common nonoccupational exposures. The medical examiner must equate his judgment of worker selection to the local prevailing compensation laws. Of particular importance are those problems associated with a legal concept of harmful exposure to radioactive material, the last employer liability, and the long latent period that may occur between alleged radiation exposure and disease. (M.P.G.)

41167 AN ANALYSIS OF THE HEALTH OF URANIUM MINERS IN YUGOSLAVIA. D. Karajović, D. Panov, M. Kilibarda, M. Medjedović, M. Jeremić, S. Savić, M. Jovanović, D. Cvetković, and S. Dodić (Inst. of Occupational Health, Belgrade). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/61, 18p. (CONF-104-42). (In French)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

For 4 years the Institute of Industrial Medicine in Belgrade has been medically examining workers in the Yugoslav U mine, devoting special attention to signs of damage to the respiratory tract caused by Rn and radioactive and siliceous dust, changes in hematopoiesis due to chronic irradiation and to radioactive contamination, the appearance of radiation-induced dermatitis, impairment of eyesight, and kidney disorders resulting from the nephrotoxic effect of U. The investigations have revealed disorders of the upper respiratory passages in up to 40% of the workers examined, bronchitis with emphysema in about 18%, pneumoconiosis L in 11.3%, pneumoconiosis Z in 7.6%, and silicosis in 2.3%. The changes in hematopoiesis are not very significant. Anemia occurs in 0.5% of cases, leukopenia in 1.75%, lymphocytosis in 2.5%, and neutropenia in 2.5%. Dermatological examination shows that persons working with U compounds can acquire skin disorders, since dermatitis was discovered in 1.4% of the cases examined. Examination of the eyes and urinary tract has disclosed no lesions attributable to irradiation, radioactive contamination, or the nephrotoxic action of U. (auth)

41168 CONTROL OF ENVIRONMENTAL CONDITIONS IN THE DRYING AND CALCINING OF URANIUM OXIDE AT CALCINED PRODUCTS LTD. (SOUTH AFRICA). S. R. Rabson and W. W. Bath (Dept. of Mines, Johannesburg). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/13, 21p. (CONF-104-14)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

U oxide slurries, comprising the final product from all the extraction plants, are delivered to Calcined Products Ltd., where they undergo a process of filtration, drying, and calcining. A semicontinuous plant is used, in which all the processes are totally enclosed and connected to a ventilation system with appropriate dust collection equipment. A description is given of the measures which are applied to reduce dust production to a minimum. A program of sampling for U dust includes samples taken during the week by plant personnel and a monthly survey by officials of the Chamber of Mines. U concentrations are maintained generally under 50 $\mu g/m^3$, with very few results up to ~150 $\mu g/m^3$. A radiation survey is carried out annually; generally very low levels are indicated except at bulk accumulations of the product where values up to 2 mr/hour have been recorded. A regular scheme of urinalysis is carried

out in which all personnel employed in the plant are examined for urinary U content every month. Results show generally very low values, and only exceptionally are values obtained over 0.05 μg U/ml. (auth)

41169 THE EVALUATION OF RADIUM D HAZARDS IN A URANIUM MINE. Z. Jaworowski (Inst. of Nuclear Research, Polish Academy of Sciences, Moscow). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/54, 18p. (CONF-104-37)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The concentration of Rn^{222} and RaD in the air of a Polish U mine was measured and found to be 1500 picocurie/l and 1.66 picocurie/m^3, respectively. About 53% of RaD was in insoluble form. From these data, the concentrations of RaD in the U miners' skeletons, lung tissue, mediastinum lymphatic nodes, and other soft tissues and the corresponding radiation dose rates were calculated. The critical organ for RaD chain in U miners was found to be the mediastinum nodes. In 57 U miners' hair samples, the mean concentration of RaD was found to be about 40 times higher than the mean concentration in unexposed people. The mean concentration of RaD in U miners' bones was calculated. The determination of RaD hair concentration as a simple way of assessment of the cumulative exposure to this nuclide is discussed. Some problems of calculation of RaD chain radiation dose to the skeleton are critically reviewed. (M.P.G.)

41170 PROTECTION OF WORKERS AGAINST RADIOACTIVE GAS AND DUST. M. Kačarević (Zavod za Nuklearne Sirovine, Belgrade). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/62, 37p. (CONF-104-47)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The problems related to workers' protection when working with natural U are presented. Hazard and safety precautions necessary to protect personnel against radioactive gases and dust are discussed. Determination of the efficiency of the applied collective protection was based on the methods of radiological physics and radiological chemistry. World and Yugoslav standards are used for the estimation of personal safety. Finally, recommendations are given for the radioactive protection based on experience gained during a 5-year period of systèmatic safety control. (auth)

41171 ON THE EVALUATING METHOD OF AIRBORNE DAUGHTERS OF RADON. EXPERIMENTAL STUDIES ON THE VARIETY OF RADON DAUGHTER COLLECTION EFFICIENCIES OF SEVERAL FILTER MEDIA UNDER VARIOUS CONDITIONS OF MAKE UP TEST AIR. T. Inoue and Y. Yamada (Musashi Inst. of Tech., Kawasaki City, Japan). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/5, 17p. (CONF-104-7)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

The method (sampling with filter media, scaling of α and β disintegrations on the filter media, and calculating initial atom numbers of α and β emitters on the filter media from scaling data) is a common evaluating method of short-lived airborne daughters of Rn. The collecting efficiencies of filter media depend on various factors such as sampling rate, humidity, and quality and particle size distribution of Rn daughters and other aerosols. Various conditions of test air were made up in a closed test-air-circulation system and collecting efficiencies of several filter media were tested under various sampling rates and durations. Data on the variations of Rn-daughter collecting efficiencies of several filter media under various conditions of sampling air are presented in graphs. (M.P.G.)

41172 INTERNAL CONTAMINATION BY RADON-222 AND ITS RADIOACTIVE DEPOSIT. J. Lafuma (Commissariat à l'Energie Atomique, Paris). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/14, 8p. (CONF-104-15). (In French)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

Pulmonary contamination by Rn and its radioactive deposit depends upon the presence of dust in the air, and internal contamination will also depend upon it to the extent to which fixation of the radioactive deposit hinders its penetration into the organism. Rn metabolism was studied. The total dose, topographic distribution, and blood concentration kinetics were recorded; to study the metabolism of the rare gases the same measurements were made for Xe. A cross-circulation method was used to study the topography of radioactive deposit retention after it has passed into the organism. The circulatory systems of two animals were crossed, the air from the initial donor containing Rn and radioactive deposit, while the receiver, exhaling Rn only, takes up radioactive deposit. In experimental conditions of this kind, no secondary localization of this short-lived radioactive deposit occurs. (auth)

41173 CONTAINER FOR RADIOACTIVE ISOTOPES. Hermann Charles Pontet. German Patent 1,152,203. Aug. 1, 1963. Priority date July 28, 1959, Great Britain.

A container for radioactive material is described that has improved means for effecting actuation of the radioactive source from its repose position to its active position whereby such actuation is greatly facilitated and fail-safe operation is assured. The container consists essentially of two separable parts one of which contains the radioactive material and the other one serves for shielding purposes. The mechanism connecting the two parts of the container is arranged so that for actuating the container it is only necessary to rotate the upper part. (Gmelin Inst.)

41174 PROCESS FOR REMOVAL OF RADIOACTIVE CONTAMINATION. Elmer L. Brevik (to Purex Corp., Ltd.). U. S. Patent 3,108,080. Oct. 22, 1963. Filed Sept. 23, 1955.

A process is described for removal of radioactive contaminants emitting alpha, beta, or gamma radiations from a surface. The surface is contacted with an aqueous solution of a water-soluble glassy phosphate in the form of a polyphosphate having a $M_2O:P_2O_5$ mole ratio of about 0.9 to 1.3, with M a member of the alkali-metal and ammonium group, and either ammonium carbonate or ammonium bicarbonate. The solution has a pH of from about 6 to about 9. (M.C.G.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

Refer also to abstracts 40443, 40485, 40486, and 40487.

41175 (NP-13170) COMPONENTS OF IONIZED IRRADIATED MEATS INJURIOUS TO REPRODUCTION. Progress Report, March 1, 1963. J. K. Loosli, C. M. McCay, and A. C. Stevens (Cornell Univ., Ithaca, N. Y.). Contract DA-49-007 MD-600. 4p.

Diets containing irradiated beef had no effect on the growth or reproductive performance of dogs. Results are reported from long-term feeding experiments. (C.H.)

41176 (NP-13171) RADIOISOTOPES IN RADIATION PROCESSED FOODS. Final Report. George R. Meneely (Vanderbilt Univ., Nashville. School of Medicine). Apr. 1963. Contract DA-49-193-MD-2101. 71p.

No positive evidence of induced radioactivity was detected in canned pork, beef, ham, chicken, or bacon irradiated with Co^{60} γ radiation or electrons below 12 Mev. At and above 12 Mev, the isotopes Sc^{47}, Xe^{133}, Mn^{54}, Sc^{46}, Na^{24}, and Sc^{48} were detected and identified by use of a whole-body counter, γ-ray-spectrometric analysis, and analysis for β-emitting isotopes. Digested samples of the irradiated foods and controls were also analyzed. No increase in β emitters was detected in foods irradiated at energies below 12 Mev. (C.H.)

41177 (NP-13173) TO DETERMINE THE EFFECT OF IRRADIATION UPON THE WHOLESOMENESS OF FOOD. Progress Report No. 15, September 1962–March 1963. Elwood F. Reber and Om P. Malhotra (Illinois. Univ., Urbana. Coll. of Veterinary Medicine). Contract DA-49-007-MD 72800. 14p.

Preliminary studies on rats fed a diet containing 45% irradiated beef showed that weight gain was greater and food conversion was better for rats fed nonirradiated beef than for those fed irradiated beef. The hemorrhagic syndrome in rats was overcome by the addition of vitamin K to the ration. Diets containing irradiated beef or irradiated flour had no significant detrimental effects on growth, feed conversion, fertility, or lactation in dogs during a 2-yr period. (C.H.)

41178 (NP-13180) THE GROWTH, BREEDING, LONGEVITY AND HISTOPATHOLOGY OF RATS FED IRRADIATED OR CONTROL FOODS (HISTOPATHOLOGICAL STUDIES). Final Report, April 1, 1957. J. F. Bone (Oregon. Agricultural Experiment Station, Corvallis). May 28, 1963. Contract DA-49-193-MD-2064. 24p.

No positive relation between radiation processing and wholesomeness of foods was found in rats maintained on a diet containing irradiated pork, peaches, carrots, jam, or flour. Gross observations and microscopic analysis was done on all tissues that showed lesions. Pathological conditions in rats associated with age and tumors in experimental and control rats are described. (C.H.)

41179 (NP-13181) THE CARCINOGENIC PROPERTIES OF IRRADIATED FOODS. Final Report, April 16, 1959–October 1, 1961. J. C. Calandra and John H. Kay (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). Contract DA-49-007-MD-895. 41p.

Diets containing 6 irradiated foods had no significant adverse effects on body weight, life span, or tumor incidence in mice. Results are reported for long-term feeding experiments in which irradiated codfish, beef stew, chicken stew, green beans, peaches, and flour were included in the diet. (C.H.)

41180 (AEC-tr-5632) RADIOACTIVE ISOTOPES AND THE CONSTRUCTION INDUSTRY, INTERNATIONAL COLLOQUIUM, LEIPZIG, SEPTEMBER 28-30, 1960. A translation of p.1-152 from Wiss. Z., Hochsch. Bauwesen, Leipzig, Sonderdruck, 1961. 318p.

Twenty-six papers are presented on the problems of applying nuclear techniques to the construction industry. These applications include analysis of concrete for density, hollow spaces, and reinforcements; studies of rotary kilns; analysis of moisture content of building materials; radiation effects on building materials; site studies; and hydrologic applications. (D.L.C.)

41181 A NEW METHOD FOR MEASURING THE DEPTHS OF EMBEDDED RADIOTRACER ATOMS USING A PRECISION β-RAY SPECTROMETER. R. L. Graham, F. Brown, J. A. Davies, and J. P. S. Pringle (Atomic Energy of Canada Ltd., Chalk River). Can. J. Phys., 41: 1686-1701(Oct. 1963). (AECL-1825)

A quantitative method was developed for measuring the mean depth within a solid of those radioactive atoms which decay with the emission of monoenergetic conversion electrons. By acceleration to kev energies in a mass separator, 16.8-hour Xe^{125} atoms were injected into metal foils, and the intense K 54.96 and K 188.4 conversion lines were then scanned in the Chalk River $\pi\sqrt{2}$ β-ray spectrometer. The manner in which these conversion-line shapes varied with Xe^{125} depth was calibrated by covering the foil surfaces with known thicknesses of Al or Au; it was found that the peak heights decreased in an approximately exponential manner with increasing Xe^{125} depths. With this calibration, mean depths can be determined under unknown conditions; the maximum sensitivity is about 6 atom layers (15 Å) under the most favorable conditions. Examples are given of the application of the method to metal oxidation studies and to Xe^{125} range measurements. (auth)

41182 INVESTIGATION OF THE MOVEMENT OF MOLTEN IRON IN THE BLAST FURNACE HEARTH. Hisashi Mori and Midori Matsuo. Genshiryoku Kogyo, 9: No. 7, 22-6(July 1963). (In Japanese)

The movement of molten iron in the hearth of a blast furnace was determined, using Co^{60} as the tracer element. Two different blast furnaces of the Yowata Iron Manufacturing Company were used for the study, which involved the introduction of 1 to 4 millicuries of Co^{60} into the charge; the radioactivity of the molten iron samples tapped was then determined as a function of the lot number, using a scintillation counter for the measurements. Analysis of the results showed that there is a certain amount of motion of the molten iron in one of the blast furnaces but practically no movement could be detected in the second furnace. It was concluded that the design and the operating conditions used affect greatly the movement of the molten iron in the furnace. (TTT)

41183 APPLICATION OF A DOUBLE RADIOISOTOPIC TECHNIQUE TO PROCESS ANALYSIS. Toru Hirayama, Kauyoshi Hamada, and Komin Osada. Genshiryoku Kogyo, 9: No. 7, 27-30(July 1963). (In Japanese)

A double radioisotopic technique was used for determining certain features of the carbon black manufacturing process. The tracer mixture used consisted of 0.1-ml H_3PO_4 (including 10 millicurie P^{32}), 2-ml concentrated HCl, 0.278-g AuCN, and 7-ml NH_4OH. The mixture was added to the raw oil and the activity of the P^{32} in the samples taken from various locations was determined by means of a G-M counter. The Au content of the samples was determined by γ-spectrometry, after activating the material in the neutron flux of a reactor. The retention times and the flow patterns obtained by means of these parallel measurements agreed quite well with each other; both materials acted as true tracers. It is claimed that the simultaneous use of two or more different tracers improves the accuracy and the reliability of process analysis. (TTT)

41184 RADIOACTIVE STRAHLENQUELLEN IN DER TECHNIK. (Radiation Sources in Technology). Siegfried Koch. Leipzig, VEB Deutscher Verlag für Grundstoffindustrie, 1960. 120p.

The application and utility of nuclear energy in industry is discussed. Radiation adsorption and its application, radiation scattering and its application, utilization of radio-induced ionization of gases, and the modification of the physical and industrial properties of solids are treated individually. 116 references. (tr-auth)

41185 PRIMENENIE RADIOKATIVNYKH IZOTOPOV DLYA IZUCHENIYA STAL'NOGO SLITKA. (Use of Radioactive Isotopes in Steel Ingot Structure Studies). M. I. Gol'dshtein. Moscow, Metallurgizdat, 1963. 184p.

Investigations of steel ingots by means of radioisotopes is discussed. Data are given on certain radioisotope properties and applications as labeled atoms. Data are also given on the structure, crystallization, and dendride liquation of the specimen. (R.V.J.)

41186 MARKIERTE ATOME IN DER KATALYSE. (Labeled Atoms in Catalysis). L. J. Margolis. Leipzig, VEB Deutscher Verlag für Grundstoffindustrie, 1961. 78p.

The application of isotopes in catalytic research is reviewed. The catalysts with regard to their foreign atoms, the mobility of the atoms, the heterogeneity, and the radiochemical determination of their surface are described. The mechanism of catalytic reactions, especially in cracking methods, in the synthesis of hydrocarbons, and in the dehydration of butane and butylene, was investigated. The advantages and future prospects for the use of isotopes in catalysis research were indicated. (J.S.R.)

41187 MARKIERTE ATOME IN DER TECHNIK. (Labeled Atoms in Technology). Siegfried Koch and Helmut Loeffler. Leipzig, VEB Deutscher Verlag für Grundstoffindustrie, 1962. 197p.

The theory of the labeling methods and the devices used for the detection of radioactivity are described. The application of labeling techniques to industry is discussed. Methods without necessary chemical identity of indicator and labeled material, labeling with radioisotopes of the same element, and some special labeling methods are considered. 208 references. (tr-auth)

41188 RADIATION APPLIED IN PROCESS CONTROL SYSTEMS. M. J. Luthman (Industrial Nucleonics Corp., Belmont, Calif.). New York, Institute of Electrical and Electronics Engineers, 1963, Preprint Paper 63-1211, 11p, $1.00. (CONF-201-7)

From Pacific Annual Meeting, Spokane, Aug. 1963.

The need for process control systems, radiation measuring systems, principles of process control, and advantages of process control systems are discussed. (M.C.G.)

41189 METHOD OF MEASURING A VARIABLE CONDITION BY USE OF SHORT HALF-LIFE RADIOACTIVE SOURCE MATERIAL. Willard D. Cheek and Henry K. Willcox, Jr. (to General Motors Corp.). U. S. Patent 3,106,641. Oct. 8, 1963. Filed Nov. 5, 1958.

A method is described in which a normally stable isotope is activated to a short-lived isotope by irradiation, and the short-lived product is then used to measure cyclic processes. Some applications include the measurement of rotational speeds by placing a small sample on the periphery of the rotor and monitoring the rate at which the activated sample passes a counting head; and the measurement of sheet thicknesses by rolling the sheet across a roller that is coated with an activated isotope. The roller in this case is coated uniformly with the stable isotope that is to be activated. The counting rate is a function of the sheet thickness. Neutron-, gamma-, and charged-particle-induced reactions can be used for this procedure. (T.F.H.)

INSTRUMENTS AND INSTRUMENTATION

General and Miscellaneous

Refer also to abstracts 40703, 40704, 40718, and 41569.

41190 (AD-289361) 6 INCH f/3.5 AND 9 INCH f/4.5 RADIATION PROTECTED AERIAL RECONNAISSANCE LENSES. Final Report. (Bausch and Lomb Optical Co., Rochester, N. Y.). [1962]. Contract WADD 33(616)-7071. 17p.

Glasses resistant to severe discoloration under irradiation were produced by replacing Sb_2O_3 and/or As_2O_3 in the composition with CeO_2. Radiation resistant red and yellow filter glasses were obtained by altering the base glass type upon addition of CeO_2 and by applying a multilayer film to the base glass. Ten lenses (five-6-in., f/3.5 and five-9-in., f/4.5) submitted for testing met the requirements for resolving power, equivalent focal length, back focal distance, flange focal distance, front vertical focal distance, relative illumination, transmittance, relative aperture, and distortion. Both resistant and nonresistant lenses were tested. Transmission losses from radiation (up to 10^6 roentgens/hr) in the protected lenses followed losses predicted from tests on glass blanks. Thermal shock did not impair lens operation or performance, and the lens materials did not become radioactive when exposed to 10^6 roentgens of Co^{60} gamma radiation. (D.C.W.)

41191 (CEA-Note-424) CAMERA DE TELEVISION MINIATURE. (Miniature Television Camera). (France. Commissariat a l'Energie Atomique. Centre de Production de Plutonium de Marcoule, Chuscian). 1963. 18p.

Modifications were made to Grundig television camera to reduce its size and increase its sturdiness and interchangeability. The cowling is cylindrical and is mounted on a skeleton with the electronic equipment. These are described and illustrated. The modifications to the electric and electronic characteristics are given. The image quality was preserved, heating was not increased, the mechanical behavior is improved, and its utilization is expanded. (J.S.R.)

41192 (D2-9878-5) TRANSIENT RADIATION EFFECTS INSTRUMENTATION TECHNIQUES. (Boeing Airplane Co., Seattle). [1962]. 171p.

A detailed description is given of generally applicable techniques for transient radiation effects testing and data analysis and of the evaluation of these techniques. The Kukla pulse reactor and the Boeing flash x-ray facilities were used to simulate a nuclear weapon burst. The topics discussed are: equipment for remote operation at the Kukla reactor, signal perturbations in transmission lines, basic rules for the tests, lead and paraffin shields for altering the neutron-to-gamma ratio at Kukla, a cathode follower circuit for impedance matching to signal transmission lines, balanced cable techniques, current probe and its radiation response, data reduction, and evaluation of TIMM devices. (D.L.C.)

41193 (NLCO-893) RECENT ADVANCES IN COULTER COUNTER PARTICLE SIZE ANALYSIS. D. L. Wilson (National Lead Co. of Ohio, Cincinnati). Sept. 17, 1963. Contract AT(30-1)-1156. 14p. (CONF-253-2)

From 13th Annual National Lead Company Analytical and Physical Testing Symposium, Hightstown, N. J., Oct. 1963.

The Coulter Counter is an electronic instrument with which small sample particles may be counted in increments from <1 to 250 microns. The technique consists of suspending a sample in an electrolyte that is inert to the sample, then forcing a known volume through a small orifice having an electrode on each side. In principle, the measurement is related to a change in resistance between the electrodes proportional to the volume of electrolyte displaced by essentially single particles passing through the orifice. Equations were developed by which any number of distribution curves for orifices may be mathematically connected or corrected for sieving. A composite distribution curve may be obtained regardless of the particle size range. An equation was developed that makes possible a more accurate calibration of each orifice. By using a differential pulse height analyzer in conjunction with the electronic unit of the instrument, data are more readily obtained, especially in the preparation of differential distribution curves. (auth)

41194 (TID-19533) TEMPERATURE MEASUREMENTS USING SMALL QUANTITIES OF CERIUM MAGNESIUM NITRATE. W. R. Abel, A. C. Anderson, and J. C. Wheatley (Illinois. Univ., Urbana). [1963]. Contract AT (11-1)-1198. 24p.

A study was made of the requirements of a mutual inductance system suitable for precise temperature measurements using about one gram of cerium magnesium nitrate. The mutual inductance is measured by an electronic bridge originally proposed by Pillinger, Jastram, and Daunt. The effects of spurious magnetic materials, of nearby paramagnetic salts, and of the vacuum jacket are discussed. The linearity and stability of the electronic bridge as well as the effects of external circuitry are also discussed. Results are given for the properties of two coil sets with cerium magnesium nitrate thermometers used to test the stability of the bridge and the validity of expressions for mutual inductance obtained in the test. It may be concluded that if solid air can be kept away from the coils the long term instabilities for a 1 gm thermometer lead to errors of about $0.004°K^{-1}$ in 1/T. A comparison between ballistic and 17 cps bridge measurements down to 0.015°K showed that $1/T^*$ as determined by the two methods was the same with an error of less than 0.1%. (auth)

41195 (UCRL-10503) A SOLID-STATE AMPLIFIER WITH A 3-NANOSECOND RISE TIME. Larry Scott (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 9, 1962. Contract W-7405-eng-48. 11p.

Presented is a design for a solid-state amplifier with the following characteristics: Voltage gain: 3 to 10, continuously adjustable. Rise time: 10 to 90%, 3 nsec. Output range: +1.5 to −1.5 volts, in a 50-ohm system. Impedance: 50-ohm matched input, emitter-follower output. Broadband design techniques are used throughout so that no tuning is required. (auth)

41196 CIRCULATING LOOP FOR INFRARED SPECTRA OF REACTING GASES AND OTHER APPLICATIONS. D. F. Smith, W. G. Schwab, and T. G. Burke (Oak Ridge Gaseous Diffusion Plant, Tenn.). Appl. Optics, 2: 1165-8 (Nov. 1963). (TID-18716)

A circulating loop providing for the examination of the infrared spectrum of corrosive gas mixtures is described. Its uses are illustrated by the study of the xenon–fluorine reaction and by the determination of saturated vapor pres-

sure of uranium hexafluoride at pressures below 1 cm of mercury. (auth)

41197 A RECORDING SPECTROMETER FOR FERROMAGNETIC RESONANCE MEASUREMENTS IN THE WAVE LENGTH RANGE AROUND 3.2 CM. E. Glauche and F. Voigt (Institut für Magnetische Werkstoffe, Deutschen Akademie der Wissenschaften, Jena, Ger.). Exptl. Tech. Physik, 11: 196-202(1963). (In German)

A spectrometer for ferromagnetic resonance investigations on ferrites was described. It records the square of the imaginary part of the complex permeability, permits measurements at different temperatures, and is suitable for routine measurements. It consists essentially of a reflecting cavity arranged in a bridge. Without sample absorption, the bridge was completely equalized. With small sample effect, a signal arises that is proportional to the square of the sample absorption. It was amplitude modulated with 9 kHz, processed electronically, and recorded with a compensation recorder. The cavity used possesses a small output aperture for withdrawing energy for frequency stabilization and for testing the sample effect. The theoretical basis for the principle of measurement, the construction of the spectrometer, and the accuracy of the measurement method used was described. (tr-auth)

41198 STABILIZING DEVICES FOR A 2-MV CASCADE GENERATOR. H. Beine (Kernphysikalisches Institut, Deutschen Akademie der Wissenschaften, Zeuthen, Ger.), G. Bohm, and S. Bohm. Exptl. Tech. Physik, 11: 203-6 (1963). (In German)

A control circuit for extended energy stabilization of accelerated protons was described. A 2-Mv net output cascade generator with accelerating tube was used as accelerator. The control signal produced by the magnetically deflected H_2^+ beam on two electrodes limiting the beam by utilization of the secondary electrons released controls the feed of the high voltage installation over a transducer circuit. The long-time oscillations still remaining in switched-in control are less than 0.5% in contrast with several percent without control. Oscillations occurring in <0.5 sec (waviness and corona discharge) are not affected by this device. The same control device was also used for the stabilization of the neutron intensity from a $Be^9(d,n)Be^{10}$ reaction, in which a BF_3 counter placed in the vicinity of the target was used as the metering element. The stability was improved by a factor of 5 through the use of this device. (tr-auth)

41199 THE PROBLEM OF THE CLASSIFICATION OF RELAY SOURCES USING NUCLEAR RADIATION SOURCES. A. G. Vasil'ev, I. S. Zhitomirskii, and K. S. Klempner. Izmeritel. Tekhn., No. 7, 53-6(July 1963). (In Russian)

The choice of a meaningful criterion presents problems in attempting to develop classification schemes for relay stations because α, β, γ, and neutron radiation sources, scintillation counters, ionization chambers, and other types of detectors may be used in a given system in a variety of structural arrangements. A number of typical cases of the counting-rate function n(t), embodied in the various instruments were reviewed. The cases considered included recording the presence of the object, the distance, the dose rate, and the absorption of the radiation. Formulas were derived for solving the problem by approximation. The chief difficulty of nuclear instrumentation is considered to consist in the development of computing methods which would ensure that the best parameters are always chosen; this can be achieved only in a few cases. In the engineering design of instruments a due allowance must be made for the fluctuation of the signal. (TTT)

41200 APPLICATION OF THE GARRETT METHOD TO CALCULATION OF COIL GEOMETRIES FOR GENERATING HOMOGENEOUS MAGNETIC FIELDS IN SUPERCONDUCTING SOLENOIDS. H. L. Marshall and H. E. Weaver (Varian Associates, Palo Alto, Calif.). J. Appl. Phys., 34: 3175-8(Nov. 1963).

The design and construction of a superconducting solenoid generating a magnetic field of high homogeneity is discussed. The design is based on the Garrett mathematical description of a magnetic field produced from a set of axially symmetric coils. The experimental results for a 1.75-in. ID solenoid, operating at either 10 or 24 kilogauss and possessing end-correcting coils in an arrangement determined by theory, indicate a central field homogeneity of $1/10^5$ over about 1 in. at 10 kilogauss and 0.75 in. at 24 kilogauss. At approximately 9.4 kilogauss it was possible to clearly resolve the three chemically shifted proton NMR peaks of ethyl alcohol. This result indicated a homogeneity of $1/10^6$ over the sample at a single point in the accessible field volume. (auth)

41201 APPARATUS FOR MEASURING THE DENSITIES OF LIQUIDS AT TEMPERATURES UP TO 500°C AND PRESSURES UP TO 20 kg/cm^2. R. Bessouat, H. Chavanel, and S. Elberg (Centre d'Etudes Nucléaires, Grenoble, France). J. Phys., 24: Suppl. to No. 6, 81A-6A(June 1963). (In French)

The apparatus is built for the study of organic coolants for nuclear reactors. It uses Mohr's balance principle. The weighing in a tight enclosure is made by a magnetic balance, the equilibrium current of which is automatically adjusted. The device allows measurements up to 500°C and 20 atmospheres. The accuracy of density determination is about 0.1%. Results of measurements made with diphenyl, terphenyls OMP and OM2, and terphenyl OM2 containing different concentrations of high boiling residue are given. (auth)

41202 MAGNETIC ANALYZER SUPPORT ADJUSTABLE IN THREE DIRECTIONS. Jean Roux (Institut de Physique Nucléaire, Lyon). J. Phys., 24: Suppl. to No. 6, 87A-8A(June 1963). (In French)

On a short trolley with screw jacks, a mechanical device is built for obtaining easily and accurately the position of the pole faces of the magnetic analyzer under the vertical beam of a 300-kev electrostatic accelerator. This position is defined by means of screws, and three independent movements: two horizontal translations $\pm\frac{3}{4}$" and a rotation ±2.5° around the vertical axis. (auth)

41203 AN ELECTROSTATICALLY COMPENSATED, NULL DEFLECTION ELECTRON BEAM PROBE FOR THE MEASUREMENT OF DISCHARGE ELECTRIC FIELDS. J. Lucas (Univ. of Liverpool). J. Sci. Instr., 40: 481-3 (Oct. 1963).

Employing a combination of well-known techniques, an electrostatically compensated, null deflection electron beam probe technique has been developed capable of measuring electric field strengths varying from 1000 to 5 v cm^{-1}. The limitations of this technique are discussed. This probe was used to investigate the field distortion occurring during the transition from a Townsend to a glow discharge. (auth)

41204 PULSE GENERATOR WITH STATISTICAL OR LINEAR TIME DISTRIBUTION OF THE NUMBER OF PULSES. Tomáš Fukátko and František Bílek (Inst. of Nuclear Research, Czechoslovak Academy of Sciences). Jaderna Energie, 9: 128-30(1963). (In Czech)

Pulse generators are often used instead of radiation de-

tectors in nuclear technology for the control and calibration of instruments, such as pulse integrators. The generator must be able to imitate completely the pulse rise of the individual detectors. Such an instrument was successfully developed on the basis of the specifications developed. The pulses generated cover the range from 0 to 50 v; their duration can be varied in 6 steps from 3.2 to 20 microseconds. Under usual conditions, 8 to 5000 pulses/minute can be generated; this may be reduced to 2 per minute by using an external capacitor. The instrument is able to repeat 5 preset frequencies with an accuracy of ±2.5%. For the statistical time distribution, the number of pulses may be varied from a few to 200,000 per minute. Details of the diagram included are given. (TTT)

41205 A NANOSECOND PULSE AMPLIFIER. H. Verweij (CERN, Geneva). Nucl. Instr. Methods, 24: 39-44 (July 1963). (In English)

An amplifier is described that has a current and voltage gain of 10 and a rise-time of 2 nsec. The amplifier is designed for a driving and load impedance of 125Ω, but it is adaptable to other impedances. It accepts either a positive or a negative input signal, but delivers a positive and a negative output pulse of maximum 7v on separate lines. A passive matched attenuator at the input may be used to decrease the gain by 6, 12, or 20 db or combinations of these. A servo-circuit clamps the base line of the output signal, so that no d-c shift occurs for high pulse rates. (auth)

41206 STEREOSCOPIC TELEVISION SYSTEM. W. J. O'Neill (Argonne National Lab., Ill.). Nucl. Instr. Methods, 24: 45-8(July 1963). (TID-18368; UAC-7204). (In English)

A high-resolution stereoscopic television system is developed for remote-viewing applications requiring depth perception. Two camera chains are used, their video outputs being displayed on two miniature kinescopes. The kinescopes are viewed as binoculars to provide the separate perspective images for the two eyes. Many of the difficult problems encountered in the development of stereoscopic television are overcome. In particular, the requirement of closely matched components is avoided. The resolution obtained is 500 lines for each perspective image. A lower-resolution multiple-observer system used in conjunction with the binocular device is suggested. (auth)

41207 A METHOD OF CALCULATION FOR POLE PIECES DESTINED TO FURNISH A MAGNETIC INDUCTION OF PREDETERMINED TOPOGRAPHY. G. Lucenet and J. Lafoucriere (Institut de Physique Nucleaire, Lyon). Nucl. Instr. Methods, 24: 51-4(July 1963). (In French)

Field measurements are made in the airgap of conic polepieces intended to furnish an inhomogeneous magnetic field varying inversely as r in a high-luminosity β spectrograph. Based on these measurements an analytical and graphical method is studied from which the correction to the shape of the polepieces can be determined so as to give the required induction gradient knowing the gradient generated by the unshimmed polepieces. (auth)

41208 A VOLTAGE-SENSITIVE TUNNEL DIODE DISCRIMINATOR. T. Hvam and M. Smedsdal (Universitetet, Oslo). Nucl. Instr. Methods, 24: 55-6(July 1963). (In English)

A tunnel-diode discriminator circuit with a maximum sensitivity of a few millivolts is described. It has good linearity, excellent isolation of the input from the switching circuit, and a rather high input impedance. (auth)

41209 SIMPLIFIED LINEAR SELECTION MEMORY FOR USE IN NUCLEAR PULSE ANALYZERS. K. S. Kuchela and A. Prasanna Kumar (Atomic Energy Establishment, Trombay, India). Nucl. Instr. Methods, 24: 57-60(July 1963). (In English)

A linear selection memory is developed for application in nuclear pulse analyzers. The linear selection technique is chosen for the memory because of its many inherent advantages. The use of bidirectional transistors and slow recovery diodes for channel selection results in considerable reduction in the number of components as well as the complexity of the electronics associated with the memory. Basic design considerations are given along with the necessary circuits. (auth)

41210 SQUARE-WAVE 100-Mc VOLTAGE GENERATOR WITH RISE AND FALL TIMES LESS THAN 1 nsec AND OUTPUT OF 0 TO 8 v. R. Borchi (Institut National des Sciences Appliquees, Villeurbanne, France). Nucl. Instr. Methods, 24: 123-4(July 1963). (In French)

The square-wave generator is transistorized, and has a rise time of 0.85 nsec and a fall time of 0,6 nsec. It can be arranged such that two voltage outputs may be obtained from it, in parallel. (T.F.H.)

41211 USE OF TRANSISTORS IN VAN DE GRAAFF SOURCE LEAK CONTROLS. A. C. B. Richardson and L. Costrell (National Bureau of Standards, Washington, D. C.). Nucl. Instr. Methods, 24: 129-30(July 1963). (In English)

A transistorized leak-control circuit is described that is installed in the high-voltage terminal of a Van de Graaff generator. The circuit can be used to heat independently either deuterium or hydrogen ion source gas supplies. (T.F.H.)

41212 CALCULATION AND CONSTRUCTION OF FAST BISTABLE FLIP FLOP STAGE WITH TRANSISTORS. W. Schambeck and F. W. Stanek (Technische Hochschule, Munich). Nukleonik, 5: 258-67(Sept. 1963). (In German)

In nuclear physics numerous fast counters are necessary, whose essential components are bi-stable flip-flops. The necessary theoretical considerations for dimensioning of a fast flip-flop circuit with transistors are presented. After a discussion of the static behavior and the temperature dependence of the individual transistor parameters, the dynamic behavior and the resulting dimensioning principles were investigated. The stated physical quantities from different preparations, which characterize the switch times of the concerned transistors, were investigated. As an example, the dimensioning of a circuit, which works up to 25 MHz impulse series frequency was carried out and tested. (tr-auth)

41213 EFFECT OF A R.F. SIGNAL ON THE CHARACTERISTIC OF A LANGMUIR PROBE. A. Boschi and F. Magistrelli (EURATOM-CNEN, Frascati, Italy). Nuovo Cimento (10), 29: 487-99(July 16, 1963).

The effect of a sinusoidal signal of large amplitude on the characteristics of a Langmuir probe is studied. The average values of the current collected by the probe are calculated and measured. Results are in agreement with the theory in a region near the floating potential and this allows the determination of electron temperature, plasma density, and plasma potential. (auth)

41214 HIGH-STABILITY QUARTZ GENERATOR FOR TRANSISTORS. E. V. Dvornikov, E. A. Mavrin, and N. V. Morkovin (Lab. for Instrumentation Analysis, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 85-7 (July-Aug. 1963). (In Russian)

A high-stability quartz autogenerator for transistors is described. The resonator is located in the inactive thermo-

stat. The quartz generator can serve as a source for the exciter frequency in a high resolution nuclear magnetic resonance radiospectrometer. The preparation and tuning of the autogenerator, which is very efficient and reliable, are outlined. (tr-auth)

41215 ONE-BAND UHF MODULATOR USED AS HETERODYNE IN ELECTRON PARAMAGNETIC RESONANCE SPECTROMETER. M. A. Ruban (Inst. for Semiconductors, Academy of Sciences, Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 4, 103-6(July-Aug. 1963). (In Russian)

A one-band modulator constructed with a crystal diode using a split bridge is described in which the combination of amplitude and phase modulation of the u-h-f vibrations produces a one-band signal of 0.5–0.6 m watt for modulator cut-off of 5–7 m watt. The carrier and secondary frequency suppression is not less than 50–55 db. Suppression of the higher supplementary frequency is not more than 30–35 db. The construction of the modulator is extremely simple and compact. The apparatus was successfully applied as a heterodyne in a radiospectrometer for investigating double electron resonance. (tr-auth)

41216 TRANSDUCER FOR NUCLEAR QUADRUPOLE RESONANCE SPECTROMETER IN REGION 130-320 Mc FOR LOW-TEMPERATURE MEASUREMENTS. D. F. Baisa and S. M. Ryabchenko (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 4, 107-9(July-Aug. 1963). (In Russian)

A transducer in the frequency range of 130–320 Mc for a nuclear quadrupole resonance spectrometer that is adapted for measurements at low temperatures is described. The design of a cryostat for measurements at liquid hydrogen and nitrogen temperatures is also presented. (tr-auth)

41217 ELECTRON MULTIPLIER WITH MAGNETIC FOCUSING FOR HIGH-SPEED MASS SPECTROMETER FOR SEPARATION OF IONS BY TIME-OF-FLIGHT. N. S. Belov, A. M. Bronshtein, L. N. Ozerov, and A. E. Rafalson (Lab. for Instrumentation Analysis, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 118-19(July-Aug. 1963). (In Russian)

The working principles and characteristics of a multiplier with electron focusing in crossed electric and magnetic fields are presented. The electron multiplier is adapted for a detection system for small impulse currents of a high-speed mass spectrometer with ion separation by time-of-flight. (tr-auth)

41218 APPARATUS FOR OPTIMUM SUPPLY OF FEU-33 AND FEU-36. V. V. Yakushin and Yu. Ya. Telnov (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 120-2(July-Aug. 1963). (In Russian)

The apparatus and method for obtaining improved-form, short-duration pulsed current in the collector circuits for photomultiplier tubes FEU-33 and 36 are presented. (tr-auth)

41219 MEASUREMENT OF RISE TIME IN PHOTOMULTIPLIER TUBES. E. I. Sirotinin. Pribory i Tekhn. Eksperim., No. 4, 122-4(July-Aug. 1963). (In Russian)

The rise time of photomultiplier pulses with a front of ~7 nsec was measured. A time analyzer is used for the measurements. The rise times of FEU-33 and 36 were found to lie within the limits 50-85 nsec. (tr-auth)

41220 NUCLEAR MAGNETOMETER WITH PROTON SOURCE CONSTRUCTED OF SEMICONDUCTOR DEVICES. A. G. Gordienko and I. O. Antonenko (Inst. for Automation, State Planning Commission, Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 4, 144-6(July-Aug. 1963). (In Russian)

A completely transistorized nuclear magnetometer is described. The magnetometer can measure magnetic field intensities in the range 1.5–10 k oersteds. The entire measuring region is covered by a highly sensitive proton source, which is connected to the h-f portion of the apparatus. (tr-auth)

41221 SHARP-FOCUSING X-RAY TUBE WITH FRONT INLET AND DIRECT CONTACT OF SPECIMEN WITH ANODE. M. I. Teumin, G. M. Nikolaenko, and Yu. K. Ioffe. Pribory i Tekhn. Eksperim., No. 4, 160-1(July-Aug. 1963). (In Russian)

An attempt to construct a sharp-focusing x-ray tube with the possibility of direct contact between the specimen and the anode is described. For x-ray analysis methods such contact is shown to be imperative or highly desirable. The tube operates with a voltage of 45 kv, an anode current of 300–500 μamp, and is air cooled. (tr-auth)

41222 MEASUREMENT OF THICKNESS OF FOILS AND FILMS BY MEANS OF SOFT X RAYS. S. I. Lobov and V. A. Tsukerman. Pribory i Tekhn. Eksperim., No. 4, 164-9(July-Aug. 1963). (In Russian)

For measurement of thin metal foils and organic films in the range 10^{-2}–10^{-5} cm soft bremsstrahlung and characteristic x radiation that are created in tritium are used. A Geiger counter is used as the detector. It is shown that a sensitivity up to 3×10^{-6} gm/cm^2 can be obtained by selecting the wavelength of the characteristic radiation absorbed in the K, L, or M level of the foil material. An effective method for control of metal foils and opaque films in the mass region $(5–30) \times 10^{-6}$ gm/cm^2 is proposed. (tr-auth)

41223 GENERATOR OF RIGHT-ANGLED VOLTAGE PULSES WITH LARGE AMPLITUDE. K. G. Finogenov (Moscow Inst. of Engineering Physics). Pribory i Tekhn. Eksperim., No. 4, 184-5(July-Aug. 1963). (In Russian)

A simple generator for right-angled voltage pulses is described. The amplitude of the pulses are regulated in the region 1.5–16 kv with a duration from 1–0.01 μsec. The growth and decay times of the pulse are 0.1 μsec. (tr-auth)

41224 ULTRAHIGH VACUUM INSTRUMENTATION. T. A. Vanderslice (General Electric Co., Schenectady, N. Y.). Science, 142: 178-84(Oct. 11, 1963).

A wide variety of instruments are available for measuring both the total pressure and the partial pressures of gases present in vacuum systems. Vacuum gages serve many purposes; some of them merely measure the range of the gas density. If it is desired to know the gas density within 5 percent or better, many details concerning ion gage calibration must be given careful consideration. (auth)

41225 SCIENTIFIC INSTRUMENTS IN SPACE EXPLORATION. Raymond L. Heacock (California Inst. of Tech., Pasadena). Science, 142: 188-95(Oct. 11, 1963).

The path is a long one between the conception of a scientific instrument for space exploration and the goal of obtaining scientific measurements from space, from the moon, or from the atmosphere or the surface of a planet. These instruments must be designed to meet the scientific objectives under adverse environmental conditions and within the constraints of a complex spacecraft system. The limitations of weight, power, telemetry, integration, and reliability must be assessed and appropriately dealt with in the design, development, fabrication, testing, and calibration of the instrument. The instrument must operate satisfactorily in a vacuum-thermal environ-

ment for long periods after having been subjected to extreme shock and vibration during the launch and injection sequences. To successfully fly a scientific instrument in space is an achievement involving a considerable number of man-years and dollars. Such an effort and expenditure of funds must be properly compensated through the attainment of scientific information. If billions of dollars are to be expended on the exploration of interplanetary space and of the moon and the planets, every possible effort must be made to see that this money is profitably spent. (auth)

41226 MNOGOKANAL'NYE IZMERITEL'NYE SISTEMY V YADERNOI FIZIKE. (Multi-channel Measuring Systems in Nuclear Physics). I. D. Murin and B. I. Khazanov, eds. Moscow, Gosatomizdat, 1963. 192p.

Sixteen articles are included on multichannel measuring devices in nuclear physics. Design, performance, and data storage and processing are discussed. (R.V.J.)

41227 POLUPROVODNIKOVYE IZMERITEL'NYE I UPRAVLYAYUSCHIE USTROISTVA DLYA YADERNOI ENERGETIKI. (Measuring and Control Semiconductor Installations in Nuclear Power Plants). V. V. Pavlov. Moscow, Gosatomizdat, 1962. 200p.

Applications of semiconductor devices in electronic equipment for nuclear research are discussed. Radiation effects on semiconductor apparatus are investigated, and various types of diodes, triodes, and measuring devices are described. Reactor control by diode and triode semiconductors is also considered. (R.V.J.)

41228 AN ELECTRONIC FRAMING CAMERA FOR MILLIMICROSECOND PHOTOGRAPHY. George L. Clark (Space Tech. Labs., Inc., Los Angeles). 16p. (CONF-60-2)

From Wescon Institute of Electrical and Electronics Engineers [Conference], San Francisco, Aug. 1963.

A description is presented of an image converter, or electronic camera, with the ability of repetition in the millimicrosecond range. Light from the object is focused by a lens onto the photocathode of the image converter tube (high vacuum tube with no heated cathode). The source of electrons is a photosensitive film deposited on the inside of the glass surface of the tube. Light strikes the film from the outside through the glass, and electrons are emitted on the inside, transforming the optical image into an electron image. By appropriate means, the electrons, carrying the picture information, are focused on a fluorescent screen and from this a photograph may be made by forming an image with another lens on the film. Some representative photographs are shown. (R.E.U.)

41229 ELECTRONIC INSTRUMENTATION FOR NUCLEAR DEVICE EXPLOSIONS. E. H. Hulse (Univ. of California, Livermore). New York, Institute of Electrical and Electronics Engineers, 1963, Preprint Paper 63-1224, 10p. (CONF-201-4; UCRL-7251)

From Pacific Annual Meeting, Spokane, Aug. 1963.

The information presented is a result of investigations by many engineers through the past several years. Published information is listed in the bibliography. Although the field of instrumentation for nuclear explosive devices is a very narrow one, it has produced many concepts in circuit knowledge that have served other parts of the electronics profession exceedingly well. (auth)

41230 FLOW-MEASURING INSTRUMENT. Leon Masur (to Commissariat a l'Energie Atomique). British Patent 938,856. Oct. 9, 1963. Priority date Apr. 28, 1961, France.

A flow indicator device adopted to be interposed on a conduit for detecting variations in the flow rate of a circulating fluid is presented. The meter can accurately detect a rate of flow that is twenty times less than the maximum rate. The meter has a nozzle calibrated to ensure that the level remains stable above the tank bottom when the minimum permissible rate of flow is reached. An indicator closes a warning circuit when the minimum level is reached. (C.E.S.)

41231 APPARATUS FOR VISUALIZING A NUCLEAR RADIATION SOURCE. Abraham E. Cohen (to U. S. Army). U. S. Patent 3,107,276. Oct. 15, 1963. Filed Dec. 23, 1960.

A system is described for imaging and visualizing a nuclear radiation distribution such as a gamma source. The instrument also provides for measurement of the intensity pattern of the source. The imaging lens has a thick-wall body portion of radiation-absorbent material within which is formed a pin-hole lens. The imaged radiation is received on a planar converter, which consists of a large number of individual scintillation elements arranged in a mosaic pattern covering the field of view of the lens. A matrix of nonscintillating nonmetallic optically insulating material is used to hold the scintillation elements in planar alignment. An electron tube of the image-orthicon type has a photoactive cathode positioned in close optical coupling relation to the converter. (M.C.G.)

41232 DEVICE FOR DETERMINING THE MASSES OF CHARGE CARRIERS. Werner Tretner (to Fernseh GmbH). U. S. Patent 3,107,295. Oct. 15, 1963. Priority date June 13, 1958, Germany.

An electrode arrangement for the separation of charged particles according to their mass is presented. The space available for the motion of the ions is encompassed by a series of ring-shaped electrodes, which are connected to a variable h-f source and bounded by two end electrodes. Electrons are emitted from the cathode, penetrate the end electrode, which is in the form of a grid, and ionize the region on both sides of the grid. The ions generated are accelerated and sweep through the space between the electrodes. Owing to the h-f voltage of the electrodes, the ions that are in resonance with this frequency are so much accelerated that after several oscillations they can reach the end electrode and give rise to a signal current. The magnitude of the current is a measure of the number of ions of equal mass present in this frequency range. (C.E.S.)

41233 ELECTRON PROBE X-RAY ANALYZER WHEREIN THE EMITTED X-RADIATION PASSES THROUGH THE OBJECTIVE LENS. David B. Wittry (Applied Research Labs., Inc.). U. S. Patent 3,107,297. Oct. 15, 1963. Filed Aug. 29, 1960.

Apparatus for irradiating a material with electrons and detecting x rays emitted in response to the irradiation are presented. The electrons are focused by a magnetic objective lens of short focal length to limit the surface excited by the electron beam to a diameter of less than one micron. An x-ray detection device is positioned between the electron lens and the electron source and laterally offset from the beam to detect x rays passing through the lens at an acute angle to the electron beam. (C.E.S.)

41234 POSITION INDICATING DEVICES. Jack Alexander Golder, Richard Smart, and Joseph Raymond Pendleton (to United Kingdom Atomic Energy Authority). U. S. Patent 3,108,213. Oct. 22, 1963. Priority date Mar. 31, 1959, Great Britain.

A position indicating device that meets the requirement of locating the position of a number in a sealed body by

means of apparatus outside the body is described. The electrical position-indicating device relying on change of inductance effects employs a differentially wound double coil, which is movable to follow the movement of a number of magnetic material, such that with the member of magnetic material occupying one position in the circuit, a condition of electrical balance exists in a circuit including the coil. At other positions of the member of magnetic material a condition of electrical unbalance exists in the circuit and an output derived from the circuit is employed to energize means for moving the coil relative to the member of magnetic material to the position such that a condition of electrical balance is restored in the circuit characterized in that the differentially wound coil is included in a second circuit such that should the member of magnetic material move completely out of the coil leaving the first circuit in balance, a condition of electrical unbalance exists in the second circuit. The instrument can be used for indicating the position of control rods in a reactor. (M.C.G.)

41235 RADIATION TUBING GAUGE FOR COMPUTING SINGLE-WALL THICKNESSES FROM PLURAL DOUBLE-WALL THICKNESS MEASUREMENTS. William E. Van Horne (to Industrial Nucleonics Corp.). U. S. Patent 3,109,095. Oct. 29, 1963. Filed May 25, 1959.

An apparatus for measuring the single-wall thickness of a tube in accordance with the radiation absorption of double-wall thicknesses at at least three points equally spaced on the circumference of the tube is described. It consists of a radioactive source for providing a beam of penetrating radiation, a radiation detector, means for mounting the source and the detector so they can be revolved, a measuring circuit connected to the detector for developing an intensity-proportional signal indicative of the combined wall thickness of the tube between each pair of points, a memory circuit, means for coupling the electric signals to the memory circuit, a computer for combining stored electric signals to produce analog voltages indicative of single-wall thickness at each of the points. (M.C.G.)

41236 NUCLEAR ELECTRONIC ANEMOMETER. Abraham E. Cohen. U. S. Patent 3,109,098. Oct. 29, 1963. Filed Apr. 14, 1960.

An omni-directional compensated anemometer of the nuclear type is described. The wind is allowed to pass between two speed electrodes, which are maintained a different d-c potentials. The air between the electrodes is ionized by radiation from radioactive material in the inner electrode space. The ions are attracted to the electrodes, producing a current in an external circuit. The number of ions that reach each electrode and hence the current is a function of wind velocity, since the air molecules tend to sweep the ions out of the interelectrode space. Errors due to changes in air pressure and temperature are cancelled out by connecting a second electrode structure, which is not exposed to the wind stream, but is open to the atmosphere, to the anemometer. The electrode structure is such that wind from any direction will actuate it. (M.C.G.)

41237 RADIO FREQUENCY ATTENUATOR. S. Giordano (to U. S. Atomic Energy Commission). U. S. Patent 3,110,872. Nov. 12, 1963.

A high peak power level r-f attenuator that is readily and easily insertable along a coaxial cable having an inner conductor and an outer annular conductor without breaking the ends thereof is presented. Spaced first and second flares in the outer conductor face each other with a slidable cylindrical outer conductor portion therebetween. Dielectric means, such as water, contact the cable between the flares to attenuate the radio-frequency energy received thereby. The cylindrical outer conductor portion is slidable to adjust the voltage standing wave ratio to a low level, and one of the flares is slidable to adjust the attenuation level. An integral dielectric container is also provided. (AEC)

Radiation Detection

Refer also to abstracts 40431, 41109, 41110, 41113, 41114, 41120, 41128, 41129, 41130, 41131, and 41644.

41238 (AD-289566) SOLID STATE IONIZATION CHAMBER NEUTRON DETECTORS. Final Report. (Solid State Radiations, Inc., Los Angeles). Nov. 1962. Contract DA18-108-405-cml-1012. 113p.

Results of a study of methods of utilizing the semiconductor radiation detector for neutron detection and spectroscopy are presented. The study resulted in the development of various neutron sensitive coated detectors and the Li^6 epithermal neutron spectrometer system, including the Li^6 sandwich detector and a complete integrated electronic system. Techniques for applying various neutron sensitive materials to detector surfaces were developed, and units were produced that are useful for thermal or threshold neutron detection. An analytical method is presented that adequately predicts the response of coated detectors as a function of converter material thickness, detector dead layer, and discriminator settings. The epithermal spectrometer detector developed under this program consists of a layer of Li^6 sandwiched between two detectors in an hermetically sealed package. The system is basically satisfactory, but a number of improvements should be incorporated including the selection of very thin window detectors, using lithium metal for a coating material instead of a fluoride, and determination of an optimum combination of discriminator and coincidence time settings. Operation at higher neutron energies indicated a serious interference due to neutron reactions in the silicon itself that may impose an upper energy limit for practical use of the device. (auth)

41239 (ANL-6760) Mn^{56} COINCIDENCE COUNTING FACILITY. A. DeVolpi, K. G. A. Porges, and R. N. Larsen (Argonne National Lab., Ill.). Aug. 1963. Contract W-31-109-eng-38. 113p.

A two-stage absolute counting facility for large liquid samples of aqueous $Mn^{56}SO_4$, primarily intended for better than 1% precision measurements of neutron source strengths by the manganese bath technique, is described. Two-liter samples are counted in a γ-γ coincidence arrangement that greatly improves long-term reproducibility at some sacrifice in counting statistics; this sacrifice is, however, lessened through a novel pulse-distribution scheme that allows full utilization of the output of each detector channel. The system is calibrated on an absolute scale through another unit which counts aliquots of strongly activated samples mixed with liquid scintillator in a $4\pi\beta/\gamma$ coincidence mode. The entire facility is designed to be readily adaptable to other radioisotope-counting requirements. (auth)

41240 (DCAS-TDR-62-170) CALIBRATION OF THE OMNIDIRECTIONAL PROTON SPECTROMETER. Stanley C. Freden and George A. Paulikas (Aerospace Corp. Space Physics Lab., El Segundo, Calif.). Aug. 25, 1962.

Contract AF04(695)-69. 7p. (TDR-69(2260-22)-TN-1; AD-288096)

The calibration and adjustment procedures for the subunits of the omnidirectional solid state proton spectrometer are outlined. (auth)

41241 (DCAS-TDR-62-172) MODIFICATION OF THE HIGH-ENERGY PROTON SPECTROMETER TO MEASURE ELECTRONS AND LOW-ENERGY PROTONS. F. S. Mozer, J. D. Mihalov, and D. D. Elliott (Aerospace Corp. Space Physics Lab., El Segundo, Calif.). Aug. 25, 1962. Contract AF04(695)-69. 14p. (AD-288094; TDR-69(2260-21)TN-2)

The capability of the high-energy proton spectrometer system developed to measure the flux and energy spectrum of protons above 1 Mev in the Van Allen radiation belts and interplanetary space was expanded to enable measurements of protons and electrons between 40 kev and 4 Mev. Modifications to the system include the addition of two detectors, one for low-energy protons and one for electrons, and the addition of a programmer circuit and 7 channels to the 5-channel electronic analyzer package. (auth)

41242 (EUR-422.e) PREPARATION AND CALIBRATION OF Co^{60} STANDARDS FOR INTEGRATED THERMAL FLUX MEASUREMENTS. R. Vaninbfoukx and G. Grosse (European Atomic Energy Community; European Atomic Energy Community. Nuclear Research Center, Ispra, Italy; and European Atomic Energy Community. Central Nuclear Measurements Bureau, Geel, Belgium). 1963. 20p.

At the request of the "Working group of neutron dosimetry," 3 series of Co^{60} standards for flux monitoring (0.25, 2, and 35 mc) were prepared and standardized with high precision. The maximum error of the absolute activity is ±1%. The complete standardization method, including the absolute and the relative method, is described in detail, together with a discussion of the errors. The activities of the standards are expressed also in thermal flux units, and an explanation of this choice of unit is given. (auth)

41243 (EUR-429.e) ALPHA RATEMETER WITH SOLID STATE DETECTOR. V. Mandl and L. Oliveira (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy). 1963. 11p.

A portable alpha monitor with solid state detectors is described. The full scale range is 1000 p.p.s., and an auditive indication is also provided. The battery life is about 70 hr. The instrument operates correctly in a gamma field up to 8 r/hr. (auth)

41244 (NIRL/R/42) HYPOTHESIS ASSIGNING IN THE TESTING OF BUBBLE CHAMBER EVENTS. A. G. Wilson (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). June 18, 1963. 35p.

A system developed for setting-up hypotheses against which the reconstructed events are to be tested and for recording the fits is described. A Fortran computer program permits scanning of a library tape of reconstructed events, testing each against a set of hypotheses, and production of an updated library tape. (D.C.W.)

41245 (NP-13107) ELECTRONNOE GODOSKOPECHESKOE USTROISTVO DLYA PUZYR'KOVOI KAMERY. (Electron Hodoscope Device for a Bubble Chamber). G. I. Govor and Yu. D. Klebanov (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1963. 21p.

A description is given of a bubble chamber equipped with an electron hodoscope capable of simultaneous projection of particle coordinates and masses. The hodoscope operates with ±3% accuracy and is capable of fixing three types of particles and their coordinates in passage across a 100 × 100 mm^2 space. (R.V.J.)

41246 (NP-13204) VELOCIDAD DE BARRIDO EN ESPECTROMETROS MONOCANALES AUTOMATICOS. Informe No. 83. (Sweep Velocity in Automatic Single-Channel Spectrometers). Report No. 83. Santiago F. Pinasco (Argentina. Comisión Nacional de Energía Atómica, Buenos Aires). 1963. 8p.

In obtaining the spectrum of a radioactive substance automatically, there are problems with the velocity of the voltage displacement that determines the channel with the number of counts per time unit of the integrator. By the application of very simplified assumptions on linear systems, it is shown how the sweep velocity of the voltage of the channel level and the time constant of the integrator can be selected. Formulas are given that allow the sweep velocity to be fixed as a function of the time constant of the integrator. (J.S.R.)

41247 (NRL-5938) THERMOLUMINESCENT DOSIMETERS ON RECOVERABLE SATELLITES. F. H. Attix, E. J. West, and W. E. Price (Naval Research Lab., Washington, D. C.). Mar. 4, 1963. 10p. (AD-407142)

Dosimeters for ionizing radiation, based upon thermoluminescence in CaF_2:Mn, have been described by Schulman et al. (Rev. Sci. Instr. 31: 1263(1960)). A miniature version, 1 mm diam and 13 mm long, has recently been developed at NRL. Groups of these dosimeters have been flown on six recoverable satellites, from which four payload capsules have been successfully retrieved and the dosimeters returned for readout. The polar orbits had apogees ranging from 306 to 578 km, and the satellites made 18 to 65 revolutions before recovery. The resulting absorbed doses for dosimeters shielded by 1.7 g/cm^2 of low-atomic-number material ranged from 1.8 to 4.5 millirad per orbit, based upon Co^{60} γ-ray calibrations. Dosimeters enclosed in an added 14 g/cm^2 Pb read about 43 percent less, in rough agreement with calculation based upon a trapped-proton spectrum. The observed readings are not inconsistent with the assumption that most of the proton flux was encountered in a region over the South Atlantic. (auth)

41248 (ORNL-TM-639) THE EFFECT OF THE G-M COUNTING TIME INTERVAL ON THE DETERMINATION OF THE COUNTING RATE OF SHORT-LIVED ACTIVITIES. J. J. Pinajian (Oak Ridge National Lab., Tenn.). Oct. 28, 1963. Contract W-7405-eng-26. 6p.

An examination of the percentage error in the counting rate as a function of the fraction of the half life taken for the counting time interval shows that lengthening the counting time interval will improve the statistical accuracy. The ratio of the counting time interval to the half life limits the error incurred in assuming that the midpoint of the time interval represents the time during which half the atoms have decayed. (D.C.W.)

41249 (RTD-TDR-63-3063) TRANSIENT RESPONSE OF CERTAIN ION CHAMBERS TO SHORT RADIATION PULSES. Peter M. Livingston (Air Force, Washington, D. C.). Sept. 1963. 35p. (AD-418589)

A procedure for uncoupling the charge transport and electric field equations under certain restrictions of no recombination, and dose rate limitation, in a parallel plate ion chamber is given. A solution to the first uncoupled

transport equation for a flat-topped ionization pulse, not neglecting diffusion, is obtained by finding the appropriate Green's function, and the subsequent current densities and external circuit current are derived. The usual assumption of neglecting diffusion is shown to be valid for most cases involving ion transport by an examination of the general form of the external chamber current. Variations of the external circuit current with the radiation pulse width, and ratio of negative to positive ion mobilities are given. An attempt to fit an observed record is discussed. (auth)

41250 (TID-19491) A FEASIBILITY STUDY OF A HIGH SENSITIVITY FAST NEUTRON DOSIMETER. Quarterly Report No. 3. B. H. Chase, Ta. C. Pang, J. M. Swartz, and M. O. Thurston (Continental Electronics Corp., Columbus, Ohio). [nd]. Contract AT(11-1)-1226. 3p.

Progress is reported of the development of a semiconductor fast neutron dosimeter for personnel exposure monitoring. Results are given of irradiation experiments carried out on devices of base widths of 20 to 80 mils to determine the sensitivities and damage constants. The development of a prototype high sensitivity readout system is described briefly. Device processing experiments are also described. (D.L.C.)

41251 PREVENTION OF DISTORTIONS IN EMULSIONS BY COLOPHONY RESIN TREATMENTS. J. Catala, G. Vanderhaeghe, J. Casanova, E. Villar, G. Pardo, and P. Tarrega (Universidad, Valencia). Anales Real Soc. Esp. Fis. Quim. (Madrid), Ser. A, 59: 67-70(Mar.-Apr. 1963). (In Spanish)

The shrinkage that the nuclear emulsions show after development was avoided using a colophony resin treatment. To study the distortion and swelling homogeneity in emulsions treated by this method, several plates were exposed to a 800-Mev/c pion beam at CERN; the plates were developed by both dry and wet methods, finding a decrease of about 30% in the mean distortion value when the dry method was used. (auth)

41252 AN AUTOMATICALLY GAIN CONTROLLED PULSE-AMPLIFIER. Bertil Sigfridsson (Research Inst. of National Defence, Stockholm). Arkiv Fysik, 24: 303-10 (1963). (In English)

A description of a new version of the Automatically Gain Controlled pulse amplifier is given. The amplifier gives constant output pulse-height and pulse-shape for an input pulse-height range of about 30 dB with a rise time of less than 15 ns. Input pulses with rise-times up to 80 ns are accepted. The amplifier is suitable for fast as well as slow pulses, and the time spread for the accepted pulse-height interval is less than 1 ns for fast pulses. A review of the application possibilities in the range of time measurements involving large pulse-height ranges is given. (auth)

41253 THE HIGH-FREQUENCY DEFLECTION METHOD FOR MEASURING SHORT HALF-LIVES. PART 3. THE TIME CALIBRATION, THE SHAPE OF THE TIME-RESOLUTION CURVE AND A DESCRIPTION OF SOME OF THE ELECTRONIC EQUIPMENT. Bertil Sigfridsson (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 24: 311-28(1963). (In English)

For a double-focusing sector magnet the line shape, in a plane perpendicular to the radial plane, is to a good approximation triangular. This property is used to calculate the intensity distribution, with the high-frequency sweep connected, in order to obtain the time calibration. This calibration is used when the time-resolution curve is measured by means of aperture scanning. By assuming the sine sweep to be linear with respect to time near zero deflection, a simple function for the time-resolution curve is obtained. From this function the expected resolving time and coincidence counting rate can be calculated as a function of the sweep-conditions used. The half life of the 184-kev transition in Pb^{206} is measured to be $(3 \pm 1) \times 10^{-11}$ s. A description of the high-frequency deflection system, the coincidence unit, and the principle of a multi-detector system is given, which, by means of five photomultipliers, yields 13 channels. (auth)

41254 OPTICAL THEOREM AND THE ENERGY SPECTRUM. S. A. Kholin. At. Energ. (USSR), 15: 156 (Aug. 1963). (In Russian)

Changes in the reading of instruments were investigated for the case in which the positions of the receiver and the source are exchanged, maintaining the independence of the cross section from the energy; it was assumed that the instrument integrates the readings with respect to time and direction and the source was isotropic. In contradiction to the usually expressed form of the optical theory (B. Davidson, Neutron Transfer Theory, Atomizdat, 1960) constancy of the velocity is not required in this case. This problem was subjected to mathematical analysis and it was found that the recording instrument will record the same number of particles in both cases; the angle- and time-integrated spectra also were found to remain unchanged. (TTT)

41255 CONCERNING THE RANGE OF APPLICATION OF CERIUM DOSIMETRY FOR ELECTRON BEAMS AND SOFT X RADIATION. Th. Gruenewald (Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, Ger.). Atomkernenergie, 8: 316-20(Sept. 1963). (In German)

It is shown that dosimetry can also be used for electron beams of high intensity and soft x rays of a high dosage rate if cerium sulfate solutions are used. An accuracy of more than 5% is obtained up to a dosage of 20 Mrad and at dosage rates of 0.7 Mrad/sec, provided that the work is done with great cleanliness and that the turnover of cerium(IV) ions does not exceed 25 to 35% of the initial value. (auth)

41256 THE ORANGE BETA-RAY SPECTROMETER AT BROOKHAVEN. E. L. Church (Frankford Arsenal, Philadelphia). Bull. Am. Phys. Soc., 8: 390(1963). (BNL-7424)

A description is given of the Danish orange spectrometer, which consists of six double-focusing spectrometers with a common source and a common focus. These six spectrometers are energized by a common toroidal magnetic field that is generated by iron-cored coils lying between the gaps. Prototypes operating in the United States are discussed. (R.E.U.)

41257 STUDY OF GALLIUM ARSENIDE, AS REGARDS ITS USE AS A PARTICLE DETECTOR. André Barraud. Compt. Rend., 257: 1263-6(Aug. 5, 1963). (In French)

Type-n GaAs is tried as an α-particle detector. Collection efficiencies on the order of 35% are obtained. The distribution of the electric field in the interior of the detector is traced by a photoelectric method; this method shows the possibility of producing potential barriers of great thickness, 1 mm at 800 v. The length of these barriers does not follow the $V^{0.5}$ law observed in Si and Ge. The two charge carriers are found to be mobile, but their mean free paths are found to be short. (tr-auth)

41258 A COUNTER TELESCOPE FOR COMBINED MEASUREMENTS OF THE INTENSITY OF COSMIC RAYS. S. Kavlakov. Compt. Rend. Acad. Bulgare Sci., 16: 241-4 (1963).

A telescope that was developed for purposes of combined research on cosmic rays is described. The telescope is designed for counters with an effective length of 84 centimeters and an effective diameter of 3.8 centimeters and consists of four rows of 20 counters each, those in the second and fourth rows being perpendicular to those in the first and third rows, with a lead absorber 10 centimeters thick between the second and third rows. The four telescope edges are oriented toward the four basic directions. The crossing of the counters in the telescope allows data on various directions to be collected simultaneously. Incoming pulses are fed to various electronic devices for combinations of measurements to be performed. With sufficient numbers of coincidence circuits, simultaneous recordings of the hard component of cosmic rays are possible at varying zenithal angles. (OTS)

41259 MEASUREMENTS ON HALOGEN-QUENCHED COUNTER TUBES. A. Eckardt and K. Kaschlik (Universität, Jena, Ger.). Exptl. Tech. Physik, 11: 181-9(1963). (In German)

Measurements on the time distribution of the secondary discharge of halogen-quenched counters are reported. From the pattern of the secondary discharge curves it is concluded that the secondary discharge was released essentially by metastable states. The known dependence of the plateau properties of halogen-quenched counter tubes on the series resistance R_v and the parallel capacity C_p was discussed on the basis of these curves. It was shown that the plateau rise can not be explained only by the secondary discharge number increasing with the voltage, but that the number of real counter tube discharges must also increase with the voltage. Oscillograms of the double pulse described by van Zoonen and obtained at varying counter tube voltage were shown. Photographs of the light development in the counter tube appears to confirm the mechanism of this pulse proposed by van Zoonen. (tr-auth)

41260 VOLT-AMPERE CHARACTERISTICS OF PLANE-PARALLEL IONIZATION CHAMBERS. V. S. Shevyrev and A. B. Dmitriev. Izmeritel. Tekhn., No. 7, 50-3(July 1963). (In Russian)

In the study of ionization chambers filled with high-pressure gases, the recombination of ions may be neglected if the study is carried out at ionization levels close to the cosmic-ray background. For engineering reasons, it is desirable to determine the volt–ampere characteristics of the chambers within a wide ionization density range. Four series of measurements were carried out at various ionization densities, varying the distance between the electrodes from 0.3 to 2.7 cm by means of Teflon sleeves. The ionization currents were measured by means of a compensation-type electrometric instrument with an error of ±1%; a dry cell battery, the tension of which could be varied from 0 to 4500 v, served as the high-voltage source. The results of measurements carried out using a distance of 0.9 cm between the electrodes confirmed that for a constant gas pressure, the relationship $I = F(E)$ remains identical regardless of the ionization density, indicating the absence of volume recombination; in some cases initial recombination was observed. The voltage selected determines the current losses due to initial recombination of the ions and indicates the increase in the size of the chamber required for obtaining the needed sensitivity. The chambers were filled with N_2 containing less than 0.01% CO_2 and 0.4% O_2. (TTT)

41261 A PHOTOMULTIPLIER AND ELECTRONIC STUDY OF GEIGER COUNTER PULSES IN AIR. Harold M. Herreman and Leonard B. Loeb (Univ. of California, Berkeley). J. Appl. Phys., 34: 3160-7(Nov. 1963).

A quantitative analysis of pulse sizes recorded in an air Geiger counter at 200 Torr was made, relating counting rates of various pulse types at different sensitivities and potentials along the counting plateau. Using this information and a determination of the onset of the self-counting potential, data concerning counts, pulse size, distance of pulse propagation down the tube, and pulse velocities were obtained for pressures of 100, 200, 300, and 400 Torr. Triggering on the steep rise of the electrical pulse stimulated by α particles at one end of the counter, the time of passage of the luminous pulse from one photomultiplier located at the α-particle gun, and a second viewing of the counter at a given distance along the axis could be recorded on an oscillograph screen. Large fluctuations of number of ions per pulse, distance of propagation down the tube, and velocities were noted. All these quantities increased with potential as the onset of steady corona was approached. There was a close correlation between pulse size, distance of propagation, and velocity. These are readily accounted for by the number of ions and photoionizing photons created in the avalanches produced by the initial triggering event. (auth)

41262 A TRACK SPARK CHAMBER. G. E. Chikovani, V. A. Mikhailov, V. N. Roinishvili (Inst. of Physics Academy of Sciences, Georgian SSR). Phys. Letters, 6: 254-5 (Sept. 15, 1963). (In English)

A spark chamber was studied at the time when a charged particle passes approximately parallel to the planes of the electrodes and the track is photographed through one of them. It was concluded that the possibility of spatial reproduction of charged particle tracks and the ability of recording showers make the spark chamber a true track detector and ranks it with the cloud chamber. (R.E.U.)

41263 THE DIFFUSION CHAMBER. Stanislaw Kolankowski (Pedagogical Inst., Gdansk, Poland). Postepy Fiz., 14: 349-79(1963). (In Polish)

The mechanisms of cloud chambers and diffusion chambers are described. The historical background and the theoretical foundations for design, construction, and operation are given. The principles and theoretical background are outlined for supersaturating a gas medium with a liquid vapor, and for the formation of liquid droplets in the medium along the trajectory of an ionizing particle. The calculation of the degree of saturation is included. The principles of photographing the droplets and of extracting information from the photographs are also discussed. Several designs of diffusion chambers are presented, and these include both high-pressure and low-pressure chambers. The diffusion chamber is shown to be particularly useful in detecting nuclear events because it is continuously in operation, and does not have to be pulsed as does the cloud chamber. The later designs are reliable and relatively simple to build. Gas pressures of 28 atm were used, producing a relatively dense detector volume. (TTT)

41264 GAS SCINTILLATION COUNTERS. (REVIEW). S. A. Baldin and V. V. Matveev. Pribory i Tekhn. Eksperim., No. 4, 5-18(July-Aug. 1963). (In Russian)

A review of the periodical literature in the last year on the development and uses of gaseous scintillation counters is presented. The physical basis for the scintillation mechanisms, construction problems, applications, and parameters for optimum operation of the gaseous scintillation counters are investigated. (tr-auth)

41265 FAST NEUTRON SPECTROMETER WITH BORON HYDRIDE SCINTILLATOR. V. N. Avaev, Yu. A. Egorov, Yu. V. Orlov, A. S. Frolov, and N. N. Chentsov. Pribory i Tekhn. Eksperim., No. 4, 39-45(July-Aug. 1963). (In Russian)

A random method is used for calculating the basic characteristics of a fast neutron spectrometer with one transducer and a scintillator composition of hydrogen and boron. The calculations are made for three scintillators. The efficiency of the energy separation and other characteristics of the spectrometer are determined. Analysis of the results permits the determination of the delay, coincidence, charge, and recovery time of the spectrometer. (tr-auth)

41266 FAST NEUTRON SPECTROMETER WITH SCINTILLATING MONOCRYSTAL OF LITHIUM IODIDE. V. V. Matveev, V. P. Panova, T. F. Rasskazikhina, and A. D. Sokolov. Pribory i Tekhn. Eksperim., No. 4, 46-8 (July-Aug. 1963). (In Russian)

The characteristics of a fast neutron spectrometer that uses a lithium iodide monocrystal are outlined. A method for measuring fast neutron spectra in the presence of a relatively intense gamma background is also presented. (tr-auth)

41267 MECHANICAL NEUTRON CHOPPER WITH SYNCHRONOUS ROTATING COLLIMATOR. S. M. Kalebin, G. V. Rukolaine, and V. V. Sokolovskii (Inst. of Experimental and Theoretical Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 48-53(July-Aug. 1963). (In Russian)

A mechanical neutron chopper is described that uses a rotating collimator for synchronization. The frequency of rotation of the collimator is ~250 C with a precision of more than 5×10^{-4} C by means of comparison with the frequency of quartz. The precision of the synchronization phase of the collimator relative to the phase of the chopper is ~±0.5°. (tr-auth)

41268 HIGHLY SENSITIVE CALORIMETER FOR MEASURING ENERGY OF BREMSSTRAHLUNG BEAMS OF 10^{-5} WATTS. S. P. Kruglov and I. V. Lopatin (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 53-8(July-Aug. 1963). (In Russian)

A highly sensitive calorimeter for measuring small streams of energy (10^{-5} watts) in bremsstrahlung beams from betatrons and synchrotrons was described. Basic problems related to the construction of the calorimeter, selection of absorption parameters, and parameters for the measuring apparatus were investigated. Corrections for the absorption of radiation in the calorimeter were determined. Utilizing these correction terms in the reduction of the data, it is possible to use the calorimeter with absorption coefficient 7.5 and length 8 cm in various experiments without additional tests for the loss of energy due to absorption. (tr-auth)

41269 SCINTILLATION METHOD FOR DOSIMETRY OF ROENTGEN AND GAMMA RADIATION. M. I. Arsaev and N. E. Sulimova. Pribory i Tekhn. Eksperim., No. 4, 59-63(July-Aug. 1963). (In Russian)

The high radiation sensitivity of an air-equivalent scintillator is discussed. The possibility of creating a scintillation dosimeter with a high radiation sensitivity not worse than ±6.0% in the energy range 30–130 kev with efficiency not less than 0.1 mr/hr is considered. The possibility of increasing the efficiency is also discussed. (tr-auth)

41270 MULTICHANNEL COINCIDENCE-ANTICOINCIDENCE SYSTEM. V. G. Varlamov, Yu. M. Grashin, B. A. Dolgoshein, and A. V. Samoilov (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 63-6(July-Aug. 1963). (In Russian)

The working principles and performance of a multichannel coincidence-anticoincidence system for accelerator beams are reported. The paramaters of the system for use with a phototube are given. The detection efficiency for fourfold coincidences is not worse than 99% for a resolution time of 5–8 nsec. The detection efficiency for particle anticoincidences is 99.95 ± 0.01%. The dead time of the coincidence system is ~30 nsec. The growth time of the discharge impulse is less than 10 nsec. (tr-auth)

41271 INTRODUCTION TO CORRECTIONS FOR ERRORS IN WORK WITH PULSED SOURCES. I. F. Zhezherun (Inst. of Atomic Energy, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 76-82(July-Aug. 1963). (In Russian)

Correction formulas for counting apparatus for use with pulsed sources of radiation are given. Cases of square, exponential, and arbitrary forms of radiation pulses are investigated. (tr-auth)

41272 INVESTIGATION OF SPARK DETECTOR TRIODE WITH NANOSECOND STABILITY. G. A. Mesyats and G. S. Korshunov (Tomsk Polytechnical Inst., USSR). Pribory i Tekhn. Eksperim., No. 4, 115-17(July-Aug. 1963). (In Russian)

The operation of a discharge triode with supplementary intervals that tapers the front of the actuating impulse is described. Data are presented for the discharge time and the stability of this time. The best stability for a working voltage of 14 kv was ±1 nsec. A graph is plotted showing the relation of the operation time with the length of the supplementary interval. (tr-auth)

41273 SENSITIVITY OF PHOTOMULTIPLIER TUBES FOR ROENTGEN AND GAMMA RADIATION. M. I. Arsaev, N. E. Sulimova, and K. I. Shchekin. Pribory i Tekhn. Eksperim., No. 4, 124-7(July-Aug. 1963). (In Russian)

The relation of photomultiplier current in FEU-12, 13, 16, 29, 35, and 38 with dose rate and energy of gamma and x radiation was investigated. It is shown that this relation is linear for dose rates up to 30 r/hr. The radiation sensitivity was maximum for energies of 35–45 kev and did not exceed ±25% in the energy region 100–1250 kev. (tr-auth)

41274 GASEOUS DISCHARGE SPARK ELECTRON OPTICAL IMAGE TRANSFORMER. G. Peter, A. F. Pisarev, and K. M. Falbruk (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 128-31(July-Aug. 1963). (In Russian)

A new type electron optical transformer, the gaseous discharge spark electron-optical image transformer, is described. The experimental characteristics of the apparatus are reported and its possible applications are discussed. (tr-auth)

41275 DETECTION OF TWO PARTICLES IN SPARK CHAMBER. A. I. Babaev and V. S. Kaftanov. Pribory i Tekhn. Eksperim., No. 4, 181-2(July-Aug. 1963). (In Russian)

The efficiency of a six-layer cylindrical spark chamber for detection of two particles in the decay $\mu \rightarrow e + \gamma$ and $\mu \rightarrow 3e$ was investigated. The outside diameter of the chamber is 203 mm and its electrodes were constructed of duraluminum with a gap of 7 mm. The chamber was filled with neon at a pressure of 1.1 atm. An exponential pulse with an amplitude of 11 kv was supplied to the elec-

trodes. The efficiency of the chamber is dependent on the delay time of the voltage impulse. (C.E.S.)

41276 NUCLEAR PROTECTIVE SYSTEM DESIGN FOR RELIABILITY. J. L. Cockrell (Univ. of Michigan, Madison), J. H. Magee, and V. S. Underkoffler. IEEE (Inst. Elec. Electron. Engrs.), Trans. Commun. Electron., No. 67, 388-402(July 1963).

The reliability of redundant configurations of majority logic switching circuits is mathematically developed using the system state probability method. Both repairable and nonrepairable systems are considered. A compatible set of solid-state switching circuits is described that satisfies the requirements of the mathematical models. The nuclear protective system problem is considered in detail since it is a typical application whereby long-term high reliability is a major requirement. (auth)

41277 THE MEASUREMENT OF BUBBLE CHAMBER PHOTOGRAPHS AT CERN. Michel Benot, Yves Goldschmidt-Clermont, Lucien Montanet, and Brian Powell (CERN, Geneva). Ind. At., 7: No. 7-8, 54-69(1963). (In French)

The analysis of bubble chamber photographs increasingly calls for new techniques of data processing using digital computers. After scanning the film, the measurements taken are coded and run through several successive computing stages. However, the necessity of analyzing numerous pictures has led to the design and construction of automatic measuring devices. (tr-auth)

41278 ABSOLUTE MEASUREMENT OF THE ACTIVITY OF RADIONUCLIDES BY THE β-γ COINCIDENCE METHOD. STUDY OF A METHOD FOR AUTOMATICALLY CORRECTING INSTRUMENT ERRORS. A. Gandy (Foundation Curie, Paris). Intern. J. Appl. Radiation Isotopes, 14: 385-96(Sept. 1963). (In French)

After a consideration of the strict theory of the arrangement known as the live-time integrator, it is shown how this may be applied to coincidence measurements in order to ascertain the various counting losses due to the dead times of the two channels, whatever the nature of the dead times. It is also shown for two particular cases that the proposed method also allows corrections to be made for instrumental coincidences. An experimental study enabled deductions drawn from theory to be confirmed in the case of non-cumulative dead times. (auth)

41279 USE OF THE DYE METHYL ORANGE AS A SPECTROPHOTOMETRIC DOSIMETER IN THE RANGE 500–5000 RAD. K. S. Korgaonkar and M. S. Tarakanath (Indian Cancer Research Center, Bombay). Intern. J. Appl. Radiation Isotopes, 14: 405-11(Sept. 1963). (In English)

A handy and versatile dosimetric system for measurement of air as well as tissue doses lying within the range of 500 to 5000 rad. The system is based on changes in spectral absorption on irradiation of the dye methyl orange in aqueous solution at a concentration of 10 μg/ml and pH 3.1. (P.C.H.)

41280 RADIATION DOSIMETRY WITH DYED CELLOPHANE. A. Charlesby and R. J. Woods (Royal Military Coll. of Science, Shrivenham, Swindon, Wilts, Eng.). Intern. J. Appl. Radiation Isotopes, 14: 413-19(Sept. 1963). (In English)

Bleaching of dyed cellophane was used as a method of electron and γ dosimetry over a wide range of doses and the changes were compared with those produced by α irradiation. No consistent difference was found between gamma and electrons indicating that the dose rate is not an important factor. The results with α radiation are more scattered and dependent on the penetration of alphas through the film; this can be estimated from the limiting degree of bleaching. Within the wider fluctuations there is no significant trend indicating an increased LET effect. The radiosensitivity of the film is due to some form of transfer from the base cellophane to the dye, resulting in the bleaching of the latter with an overall G-value of about 0.17 to 0.34. It was concluded that the cellophane dyed film can be used for α dosimetry within fairly wide limits of dose and accuracy. (auth)

41281 CRYSTAL SPECTROMETER FOR POLARIZED NEUTRONS. H. Beil, P. Carlos, R. Genin, C. Signarbieux, R. Joly, and J. Matuszek (Centre d'Etudes Nucléaires, Saclay, France). J. Phys., 24: Suppl. to No. 6, 89A-93A(June 1963). (In French)

A description is given of a spectrometer producing a monochromatic polarized neutron beam. Some preliminary results of a study made on such polarized beams in the energy range from a few Mev to a few ev are given. (auth)

41282 A DETECTOR FOR THE EXAMINATION OF CONTAMINATION ON LARGE SURFACES. Dániel Voedroes and Gyoergy Gyenge. Magy. Radiol., 15: 247-9 (Aug. 1963). (In Hungarian)

A very sensitive apparatus was constructed for the protection of x-ray workers using open radioactive substances. The detector is suitable also for the demonstration of beta and alpha radiation. The purity of the instruments and the integrity of the own body may be checked on any moment. It is speculated that radiation injury can be prevented in this way. (auth)

41283 A PROPOSED SPECTROGRAPH FOR HEAVY PARTICLES. J. Borggreen, B. Elbek, and L. Perch Nielsen (Universitet, Copenhagen). Nucl. Instr. Methods, 24: 1-12(July 1963). (In English)

A focusing scheme for a broad-range magnetic spectrograph with photographic plate detection is proposed. It utilizes a homogeneous sector field with the point of entrance for the central rays placed on the extension of the straight line exit boundary. Thus, all the central rays leave the magnetic field under the same angle, irrespective of energy. A survey of possible spectrographs of this geometry has shown that a sector angle of 108°.7 and an entrance angle of 35° to a very close approximation ensure second-order focusing for all points on the focal line. The focal line is slightly curved and can easily be extended to accommodate a large momentum interval. The properties of a spectrograph of this type with radii from 40 to 84 cm are evaluated and compared with other broad-range spectrographs. (auth)

41284 THEORETICAL AND EXPERIMENTAL STUDY ON THE INFLUENCE OF AUXILIARY CIRCUIT UPON THE PULSE SHAPE AND THE RESOLVING TIME OF ROSENBLUM SPARK COUNTERS. P. Laborie and D. Blanc (Faculté des Sciences, Toulouse). Nucl. Instr. Methods, 24: 22-30(July 1963). (In French)

The influence of the auxiliary circuit on the shape of pulses delivered by spark counters with anodic wire, working in the open air, is examined. For electric equivalence, it is assumed that the detector is acting as a series connector with constant resistance (provided by the discharge); a condenser, set in parallel, takes into account the self-capacity of the counter and of the connecting wires. The case where the pulse is taken out of the terminals of the charge resistance (its amplitude being unchanged), and the

case where it is taken out of the terminals of an auxiliary circuit (weaker amplitude), are discussed. The current through the detector, the voltage between its terminals and the total number of ions initiated by the spark are evaluated as a function of time. The counter working in the region of streamers is a self-quenching one. Most of the experimental tests are related to the region of sparks, where the resolving time is well known. The use of n anodic parallel wires allows the dividing of the resolving time by n; hence, values of a few microseconds are obtained. (auth)

41285 CONCERNING THE MULTIPLE-WIRE SPARK COUNTER FOR ALPHA-PARTICLE DETECTION. Gurbax Singh (Inst. of Nuclear Medicine and Allied Sciences, Delhi) and N. K. Saha. Nucl. Instr. Methods, 24: 49-50(July 1963). (In English)

A guard-wire type of multiple-wire spark counter for alpha-particle detection is designed and its operating characteristics studied. It appears that its counting properties approach those of the multiple wire-cavity spark counter. (auth)

41286 AN AUTOMATIC SYSTEM FOR BETA-RAY SPECTROMETER CONTROL. F. Konopasek and R. D. Connor (Univ. of Manitoba, Winnipeg, Can.). Nucl. Instr. Methods, 24: 66-73(July 1963). (In English)

Circuits are presented for a system of automatic control for a β spectrometer, consisting of a reference voltage source, a timing unit, and a stepping potentiometer. The action of the circuits is described. Notable features are reliable performance and good stability at moderate cost. (auth)

41287 INTERNAL SOURCE SCINTILLATION SPECTROMETRY. B. R. Joshi, G. M. Lewis, and K. M. Smith (Univ. of Glasgow). Nucl. Instr. Methods, 24: 77-80(July 1963). (In English)

The investigation of L/K, K/β^+ ratios, β spectral shapes, and extranuclear processes by internal-source scintillation methods is considered. A description is given of the well-type method, which can eliminate escape corrections in such determinations. Source distribution and activation effects that bear on this type of spectrometry are also mentioned. (auth)

41288 MEASUREMENT OF THE RADIAL FOCUSING ABERRATIONS IN THE CHALK RIVER IRON FREE $\pi\sqrt{2}\beta$ SPECTROMETER. J. S. Geiger and R. L. Graham (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Instr. Methods, 24: 81-92(July 1963). (In English)

Detailed measurements are reported of the manner in which this double-focusing spectrometer focuses electrons from a point source. An electron gun mounted on a universal joint pivot at the spectrometer source position could direct 6-kev electrons emerging from its 0.3-mm-diameter exit hole at any desired angle relative to the optic circle. The radial focusing aberrations as functions of the electron departure angles at the source, ϕ_r and ϕ_z, were deduced from the values of the spectrometer current necessary to keep the electron beam focused on a 0.25-mm-wide slit fixed in the image plane of the spectrometer. The electrons passing through this slit were detected in a Faraday cage connected to an electrometer. The radial focusing aberrations determined experimentally were compared with theoretical values computed for this spectrometer. In these computations, the dependence of the radial aberrations on the source departure angles of the electrons was found by computing the electron orbits for some 90 sets of departure angles ϕ_r and ϕ_z. The measurements confirmed theoretical predictions within the accuracy of the relative electron momentum measurements, ±0.004%. The results indicated that the spectrometer should operate without a serious loss in transmission at resolution settings of $\leq$0.005% provided that sufficiently narrow and thin radioactive sources could be prepared. As a byproduct, the aberration patterns corresponding to the apertures defined by the existing baffle system were also studied. These showed the baffles to be quite adequate for experimental work at the highest resolutions although minor modifications would permit a small increase in transmission. (auth)

41289 NUCLEAR STUDIES BY MEANS OF BETA SPECTROSCOPY WITH SCINTILLATION COUNTERS. H. E. Bosch (Universidad Nacionale de La Plata, Argentina) and T. Urstein. Nucl. Instr. Methods, 24: 109-21 (July 1963). (In English)

The possibilities of the application of scintillation counters for the detection of electrons and analysis of beta spectra are described. The figures of merit and the uses in particular cases are pointed out. The setting-up of the scintillation spectrometer and the analysis of the beta spectra of some standard sources is described. The corrections of the beta spectra for resolution and backscattering are reported. Beta-gamma coincidence measurements on Rh^{106} are performed, and beta-gamma coincidences in Al^{26} are reported. The possibilities of studying nuclear properties by means of beta scintillation counters, especially in the performance of beta-gamma angular correlations, are mentioned. (auth)

41290 NOTE ON THE ELECTRON CAPTURE PROCESS. D. W. Kerst (Univ. of Wisconsin, Madison). Nucl. Instr. Methods, 24: 122(July 1963). (In English)

The effects of the electric resistance of the wall coatings of betatron and synchrotron tubes on the beam-capture processes in these tubes are discussed. It is remarked that low-resistance coatings probably allow higher beam yields. (T.F.H.)

41291 A METHOD TO DETERMINE PARTICLE BEAM ENERGIES. G. Heymann and R. L. Keizer (National Physical Research Lab., Pretoria). Nucl. Instr. Methods, 24: 125-6(July 1963). (In English)

The energy E(0) of a beam of particles is determined by measuring the values of P(θ) for elastic and inelastic scattering of the beam particles through angle θ by a given target particle. P(θ) is any function P(E), where E = E(θ) is the energy of the scattered particles. The method compares the values of P for inelastic and elastic scattering, in such a way that the effects of any functional dependence of P on E are canceled. Thus P can be any function whatever of E, and, moreover, the form of P need never be considered. The energy of the beam particles is that for which θ = 0, viz. E(0). The method is, in principle, as accurate as the known Q value for the inelastic scattering process. (T.F.H.)

41292 LOW-LEVEL BETA COUNTING AND ABSORPTION MEASUREMENT WITH LIQUID SCINTILLATORS. P. K. Zutshi (Tata Inst. of Fundamental Research, Bombay). Nucleonics, 21: No. 9, 50-3(Sept. 1963).

A simple technique is described using liquid scintillators and photomultiplier tubes for low-level beta counting and determining hard and soft beta components in a composite source. Advantages over low-level G-M counter methods are given. Effects of grain size of suspensions on counting efficiency are discussed. (R.E.U.)

41293 DESIGN AND TECHNOLOGY OF TYPE DOB-60 AND DOB-40 HALOGEN COUNTERS. Jan Lesinski,

Ewa Kowalska, and Maciej Jankowski. Przeglad Elektron., No. 5-6, 290-2(1963).

Descriptions are given of two halogen counters for measuring gamma-ray intensity in the 0.5-40 and 2-200 hr ranges. The concentric position of the anode inside the cathode cylinder is an essential feature of the counter design, since anode centering has a considerable effect on the maximum current of the counter. This problem was solved by using steatite insulators to hold the anode in place. The cathode of the counter was made of CrFe covered with Cr_2O_3. The counters are filled with a mixture of neon and bromine. One counter operates in the -20 to +55°C temperature range and the other in the -40 to +50°C range. (TCO)

41294 FLUORESCENCE ESCAPE FROM A GAMMA DOSIMETER PLATE. Y. Feige, J. Strop, and S. Alterovitz (Soreq Research Establishment, Rehovoth, Israel). Radiation Res., 20: 247-51(Oct. 1963). (IA-798)

A general formula is derived for the fluorescence escape probability for an infinite-sheet dosimeter, as a function of thickness and absorption coefficient. The total escape probability is obtained as a sum of four integrals. The formula development is followed for both single and multicomponent dosimeters. (D.E.B.)

41295 FAST-SLOW COINCIDENCE SCHEME WITH A STABILIZATION SYSTEM. D. K. Kaipov and A. F. Pavlov. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 79-89 (1963). (In Russian)

The design and performance of a fast-slow coincidence system equipped with a stabilizing system are described. The number of γ coincidence instabilities for 11 hours of continuous operation did not exceed 1%. The resolving time of the fast coincidence scheme was 2.9×10^{-9} sec. (R.V.J.)

41296 PREPARATION OF COORDINATE GRIDS FOR SCANNING NUCLEAR EMULSION. D. S. Amankulova, Yu. T. Lukin, and K. S. Kharitonova. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 101-4(1963). (In Russian)

Coordinate grids, 7μ for spectrographic plates and 13μ for chrome-gelatin coated plates, were developed that remained intact in thick nuclear emulsions. It was found that a gelatinous layer was necessary as a binding layer between the emulsions and the plates. (R.V.J.)

41297 SPARK DETECTOR FOR RECORDING COSMIC PARTICLES. M. I. Pak and Yu. T. Lukin. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 105-11(1963). (In Russian)

Data are given for selecting efficient power supplies for spark counter operations. It is shown that the efficiencies of spark counters with identical parameters depend on electric field intensity. A 23 × 34 cm spark counter with a 1.5-mm gap and an ionization calorimeter was used in investigations of high-energy particles. (R.V.J.)

41298 GRAPHIC TREATMENT OF WILSON CHAMBER STEREOPHOTOGRAPHS. G. I. Turov. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 129-32(1963). (In Russian)

Descriptions are given of a graphic method for determining space coordinates of particle trajectories using Wilson chamber stereophotographs. (R.V.J.)

41299 RADIATION MEASUREMENT THROUGH GLASS DOSIMETRY. Umschau Wiss. Tech., 63: 542-3(Sept. 1, 1963). (In German)

Energetic radiation produces in glass of a given chemical composition optically detectable modifications that can be used for the measurement of the adsorbed dose. The properties of such a dosimeter are described. For low dose ranges from 10 to about 10,000 rad, a silver-activated phosphate glass was used and a cobalt-activated borosilicate glass for higher radiation doses. The relative sensitivity of the phosphate glass depends on the effective radiation energy. The shielding to prevent such energy dependence is discussed. The absorption coefficient of the borosilicate glass depends on the radiation dose, and the coefficient is a measurement of the dose. At 100,000 rad there is no fading in the glass dosimeter. (J.S.R.)

41300 SPARK DETECTORS FOR CHARGED PARTICLES. M. I. Daion and G. A. Leksin. Usp. Fiz. Nauk, 80: 281-329(1963). (In Russian)

Studies, published up to April 1962, on plane-parallel spark counters with constant and with pulsed input, discharge and spark chambers are reviewed. These instruments may be used for examining the tracks of elementary particles and cosmic rays. The basic principles of this type of instruments were described by J. W. Keuffel (Phys. Rev. 73, 531(1948)). These counters make it possible to measure with great precision the coordinates of charged-particle tracks during short time intervals. Although in their early form the dead time was too short, current versions of the counters may be used for flux measurements in accelerators Impact ionization may be initiated at any point of the volume between the 2 parallel flat electrodes, resulting in a clear, localized spark which may be easily photographed. After reviewing the basic time characteristics and the efficiency of the counters, the discharge chamber, described by S. Fukui and S. Mijamoto (Nuovo Cimento 11(1): 113(1959)), which operates with a gas mixture of Ne + 0.5% Ar is discussed. It is emphasized that the spark chamber is not a general-purpose instrument as the bubble chamber which reacts to all phenomena occurring in its volume, but is of special interest for studying specific processes. Its simple, rugged construction presents many advantages and it is especially useful for studying low-probability processes. (Review article; 69 references). (TTT)

41301 RANGE SPREAD OF CHARGED PARTICLES IN VARIOUS SUBSTANCES. To Ying Seb (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 787-90(Sept. 1963). (In Russian)

It is shown that the range spread of heavy charged particles in any substance can be expressed by a universal function of Y = E/I, where E is the particle energy and I the mean ionization potential. Range spread is calculated for a photographic emulsion. (auth)

41302 TRACK SPARK DETECTOR. V. A. Mikhailov, V. N. Roinishvili, and G. E. Chikovani (Inst. of Physics, Academy of Sciences, Georgian SSR). Zh. Eksperim. i Teor. Fiz., 45: 818-19(Sept. 1963). (In Russian)

Descriptions are given of a spark detector in which charged particle tracks passing approximately parallel to the electrode plane are photographed by a stereo apparatus. The chambers are capable of recording showers, thus exhibiting an efficiency similar to the Wilson chamber. (R.V.J.)

41303 CORRELATIONS OF ABSOLUTE MEASUREMENTS CARRIED OUT BY VARIOUS NATIVE AND FOREIGN LABORATORIES WITH BREMSSTRAHLUNG BEAMS. A. P. Komar, S. P. Kruglov, and I. V. Lopatin. Zh. Eksperim. i Teor. Fiz., 45: 824-5(Sept. 1963). (In Russian)

The performance and sensitivity of various ionization chambers used for measuring energy in a bremsstrahlung beam were analyzed. The sensitivity of Soviet chambers were measured calorimetrically at E_{max} = 10 to 90 Mev.

Various foreign and domestic instruments were in agreement within 2%. (R.V.J.)

41304 DER SZINTILLATIONSZÄHLER IN DER KERNTECHNISCHEN PRAXIS. (The Scintillation Counter in Nuclear Technical Practice). Rudolf Weibrecht. Leipzig, VEB Deutscher Verlag für Grundstoffindustrie, 1961. 76p.

The possibilities for the application of scintillation counters in nuclear technology and the construction of the corresponding measurement devices are discussed. Conditions for the use of scintillation counters, practical procedure in their use, and general sources of error are indicated. (J.S.R.)

41305 ELEKTRONIKA V SPEKTROMETRII YADERNYKH IZLUCHENII. (Electronic and Spectrometric Nuclear Research). L. S. Gorn, I. S. Krasheninnikov, and B. I. Khazanov. Moscow, Gosatomizdat, 1963. 292p.

Design and construction of amplitude and time analyzers are described, and their applications in nuclear physics are reviewed. Radiation spectrometers and problems arising in handling analyzing devices, pulse amplifiers, and amplitude discriminators are discussed. The characteristics and performance of transducers and of single- and multi-channel analyzers are also considered. (R.V.J.)

41306 DER SZINTILLATIONSZÄHLER. AUFBAU UND WIRKUNGSWEISE. (Scintillation Counters. Construction and Operation). Rudolf Weibrecht. Leipzig, VEB Deutscher Verlag für Grundstoffindustrie, 1961. 88p.

Principles of the detection of nuclear radiation, and the construction and operation of scintillation counters are described. The physical luminescent processes observed in both organic and inorganic scintillators are discussed. The properties of organic and inorganic phosphors are given. The discussion of secondary electron multipliers considers the various types of photocathodes and dynodes used, and the industrial construction of scintillation counters. (tr-auth)

41307 DAS GEIGER-ZÄHLROHR UND ANDERE STRAHLENDETEKTOREN. (The Geiger Counter and Other Radiation Detectors). Rudolf Weibrecht. Leipzig, VEB Deutscher Verlag für Grundstoffindustrie, 1962. 104p.

In addition to a review of modern radiation measurement devices, the theoretical principles for the operation of Geiger tubes, the most frequently used detection instrument in industry, are illustrated. The physical reactions in the ionization process and the effect of the filling gas and the electrical voltage on the various regions are described. The origin and the calculation of the decay and distribution errors and the correction for resolution time of the counter and the zero effect are discussed. The scope of the application of counter tubes industrially is indicated. (J.S.R.)

41308 MAGNETIC SPECTROMETER DESIGN FOR ELECTRON SCATTERING ABOVE 1 Bev. H. Schopper (Technische Hochschule and Kernforschungszentrum, Karlsruhe, Ger.). 11p. (CONF-122-14)

From International Conference on Nucleon Structure, Stanford, Calif., June 1963.

Design considerations are discussed for magnetic spectrometer electron scattering investigations with the higher energy (above 1 Bev) electron sources which are being developed. The spectrometers are to be used to discriminate between elastic and inelastic processes. A momentum resolution of the order of one per cent is required for these experiments. Various spectrometers are compared according to their optical properties and the number of magnets they consist of. (R.E.U.)

41309 THE APPLICATION OF LITHIUM-DRIFTED p-i-n JUNCTIONS TO RADIOISOTOPE MEASUREMENTS. Norman A. Baily (Hughes Aircraft Co., Malibu, Calif.). New York, Institute of Electrical and Electronics Engineers, 1963, Preprint Paper 63-1203, 11p, $1.00. (CONF-201-6)

From Pacific Annual Meeting, Spokane, Aug. 1963.

The use of lithium-drifted p-i-n junctions in p-type silicon was considered for applications involving the measurement and detection of certain types of ionizing radiations. These include x, γ, and β rays. Both the advantages and disadvantages which accrue because of its high density are examined critically in light of each particular application. Illustrations are given of applications in which these devices may be used without electronic circuitry. Reproducibility and reliability were examined. Extension of use for very low energy radiations (<25 kev) was considered. Comparison of results for both steady state and pulsed sources were made. Application of these devices as transducers in industrial control systems, radiography, and health physics is discussed. Those factors which presently limit applications and the possible improvements which may come about in the near future are discussed. (auth)

41310 MODE AND DEVICE FOR THE DETECTION OF FISSION PRODUCTS. (to Plessey Co. Ltd.). French Patent 1,264,136. June 19, 1959. Filed June 18, 1960.

A method of detecting fission products having radioactive daughters involves introducing the fission products into a precipitation chamber. Here the daughters are formed and precipitated onto an electrode surface covered with a film of a liquid adapted to transfer them out of the chamber to a detecting device (a scintillation counter). Preferably, the precipitation chamber has two vertically disposed plate shaped porous electrodes that face each other and form between them an interspace. The other surfaces of the electrodes are in contact with pressurized phases that can diffuse through the corresponding porous electrodes and form liquid films at the other sides. The liquid diffusing through one electrode incorporates the fission products, while the other one is a clean rinsing liquid. The fission products diffusing from its liquid film decay into the daughter products that are precipitated on the film of the rinsing liquid flowing downwards over the precipitation electrode and finally dropping into a pool from which it is led to the detection device. (IIB)

41311 MODE AND DEVICE FOR THE DETECTION OF FISSION PRODUCTS CARRIED WITHIN A GAS PHASE. (to Plessey Co. Ltd.). French Patent 1,264,249. May 8, 1961. Priority date July 27, 1959, Great Britain.

A mode of detecting radioactive fission products carried within a gas phase consists in measuring the quantity of the radioactive daughters electrostatically precipitated from the gas phase onto the free surface of an inactive liquid and in transferring these daughters by the liquid to a counter for measuring their activity. The device for performing this mode of detection comprises an electrode over which continuously flows a film of the inactive liquid; the liquid passes in a channel with a shield separating the precipitation chamber and a scintillation counter before it enters a labyrinthine channel system within the solid phosphor of the scintillation counter. (IIB)

41312 DEVICE FOR CONTROLLING THE TRANSPORT VELOCITY OF THE FILTER BAND OF MEANS FOR MEASURING CONTINUOUSLY THE CONCENTRATION OF e.g. RADIOACTIVE AEROSOLS. Wolfram Wisch (to VEB Vakutronik Dresden). German Patent 1,151,682. July 18, 1963. Filed Oct. 16, 1961.

A device is described for controlling the transport velocity of the filter band in devices for measuring continuously the concentration of radioactive aerosols. Devices of this type are used for monitoring the atmosphere or the air in workshops or in nuclear plants. The device consists of a wheel that is pressed against the band so that it rotates according to the transport velocity of the band. Attached to this wheel there is a disc. Opposite and coaxially to the said disc there is another disc that is rotated by being coupled directly to the mechanical drive mechanism of the filter band. The deviations observed between the angular velocities of the two discs indicate a discrepancy between the actual transport velocity of the filter band and to the nominal velocity imparted by the driving mechanism. (Gmelin Inst.)

41313 SCINTILLATION COUNTER. (to Harshaw Chemical Co.). German Patent 1,152,202. Aug. 1, 1963. Priority date Apr. 2, 1959, United States.

A scintillation counter assembly that consists of a scintillator crystal and a photomultiplier tube with the window of the tube optically coupled to the crystal is described. The scintillation crystal is nearly entirely covered with a reflecting material with only that part of the crystal face being excepted that is in contact with the window of the tube. The reflective coating also covers that part of the tube that is next to the crystal including the rim of the window. (Gmelin Inst.)

41314 IONIZATION CHAMBER. Leslie E. Johnson. German Patent 1,152,487. Aug. 8, 1963. Filed June 4, 1960.

An ionization chamber that is especially applicable in nuclear reactors under very high pressure, such as nuclear reactors aboard a ship, is described. The ionization chamber is provided with an inner hollow cylindrical collector electrode and an outer cylindrical high voltage electrode concentric therewith, the assembly being insulatingly supported within a closed guard cylinder. (Gmelin Inst.)

41315 APPARATUS FOR CALIBRATING RADIATION MEASURING DEVICES. Martin H. Jachter (to U. S. Army). U. S. Patent 3,107,299. Oct. 15, 1963. Filed Feb. 2, 1962.

The design of a portable device for the calibration of dosimeters is presented. A beta source is used. Dosimeters are held in a plurality of chucks rotatably mounted in a turret that is also rotatable to insure uniform irradiation. The shielding system is composed of superposed sheets of plastic and aluminum. An automatic timing device is included for measuring the exposure period. (C.E.S.)

41316 FLEXIBLE GEIGER COUNTER. H. G. Richter and A. S. Gillespie, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,110,835. Nov. 12, 1963.

A flexible Geiger counter constructed from materials composed of vinyl chloride polymerized with plasticizers or co-polymers is presented. The counter can be made either by attaching short segments of corrugated plastic sleeving together, or by starting with a length of vacuum cleaner hose composed of the above materials. The anode is maintained substantially axial within the sleeving or hose during tube flexing by means of polystyrene spacer disks or an easily assembled polyethylene flexible cage assembly. The cathode is a wire spiraled on the outside of the counter. The sleeving or hose is fitted with glass end-pieces or any other good insulator to maintain the anode wire taut and to admit a counting gas mixture into the counter. Having the cathode wire on the outside of the counter substantially eliminates the objectional sheath effect of prior counters and permits counting rates up to 300,000 counts per minute. (AEC)

41317 A RADIOMETER. E. A. Frommhold. Russian Patent 21751. Aug. 21, 1961.

The proposed instrument consists of an ionization chamber and an electrometer. The collecting electrode of the chamber is connected by the electrometer input by a condenser. The chamber is shunted by a condenser as well. The capacities of the two condensers are chosen in accordance with the given capacity of the dose-meter scale. The electrometer input is shorted and the necessary voltage is applied to the chamber from an outside source before the measurement starts. The source is then disconnected and the electrometer input opened. The ionization chamber current discharges the shunt condenser and a corresponding voltage change is delivered to the electrometer input. It is shown that the charging capacity eliminates the effect of the voltage source variations on the electrometer readings. The possibility of a wide variation in the recording range of the radiation dose, from 10 mr to 5r, by connecting a coupling condenser of the necessary capacity is another advantage. (Referativnyy Zhurnal, Izmeritel'naya tekhnika, No. 16, 1962.)

ISOTOPE SEPARATION

41318 INVESTIGATION OF CONTAMINATION PROPERTIES WITH EMPHASIS ON BROAD RANGE ISOTOPE COLLECTION IN AN ELECTROMAGNETIC SEPARATOR OF THE 90° SECTOR TYPE. J. Uhler (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 24: 329-48(1963). (In English)

Broad-range collector distributions of the radioactive isotope Kr^{85} were measured. Beam aberrations are discussed, and the expected distribution from scattering on rest gas is compared with experimental results. The effect of a simple electrostatic analyzer is described. By means of this analyzer the beam is investigated. Possible origins of low-energy spread of ions are discussed. The pressure dependence on vacuum is measured, and some merits of a differential pumping system are quoted. The precision stabilization in use is analyzed with respect to broad-range collection. The mixing-in values for the improved isotope separation are, for Kr isotopes, in the case of distant mass numbers as low as $1:3 \times 10^6$. (auth)

41319 ON THE USE OF AN ELECTROMAGNETIC ISOTOPE SEPARATOR IN A WIDE ENERGY INTERVAL. J. Uhler (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 24: 349-67(1963). (In English)

Calculations on retardation and post-acceleration devices are made, and systems applied to an isotope separator are described. A double-focusing unipotential lens is also discussed, and data of the electrolytic tank used for the potential plottings are given. Some figures of merit are given, and a few applications are discussed. Fundamental data from studies of ranges of ions (1 to 500 kev) in solids are surveyed, and the application of the separator to such studies is treated. (auth)

41320 INVESTIGATIONS OF SOME PROPERTIES OF ISOTOPE SEPARATOR BEAMS OF DIFFERENT CHARGE STATES. J. Uhler and J. Rossi (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 24: 365-76(1963). (In English)

The intensities obtainable of multiply charged ion beams of Kr and Xe in an isotope separator were measured as a function of some discharge parameters. The initially multiply charged beams were investigated with respect to the different charge components created by charge transfer to the neutral rest gas in the system. The distribution, in a broad collector range, of the singly and doubly charged beams of Kr were measured, and the effect of the correlation between elastic scattering and charge transfer is demonstrated. (auth)

41321 HISTORY AND PRESENT STATUS OF ISOTOPE SEPARATION IN JAPAN. Toshizo Titani (Tokyo Metropolitan Isotope Center). Nippon Genshiryoku Gakkaishi, 5: 768-73(Sept. 1963). (In Japanese)

The history and the present status of isotope separation in Japan are reviewed in comparison with those of the world, dividing the total history into three periods: from the discovery of the stable isotopes (1912) to the discovery of the heavy hydrogen (1931), from this to the invention of the atomic reactor (1942), and from this up to the present. (auth)

41322 A THEORY OF ISOTOPE SEPARATION BY TWO PHASE DISTRIBUTION. Hidetake Kakihana and Kimiko Kurisu (Tokyo Inst. of Tech.). Nippon Kagaku Zasshi, 84: 470-3(1963). (In Japanese)

The separation factor for systems involving a series of complexes, AX_n, in the first phase was examined theoretically, to find the best chemical isotope fractionation process between two phases. The separation factor of isotopes A and B between two phases S_A^B, is divided into two terms: $\ln S_A^B = \ln {}_A^B K_z + \Delta$, where ${}_A^B K_z$ is the equilibrium coefficient for isotopic exchange reaction of AX_z and BX_z between two phases which is nearly constant, and Δ is a variable. Δ was evaluated for 4 possible cases. (1) Systems in which only one species, AX_z, is extractable by the second phase: $\Delta_{z,p}$. (2) Systems in which a species, AX_z, and lower species AX_{z-p}, are extractable by the second phase: Δ_{z+q}. (3) Systems in which a species, Ax_z, and higher species, AX_{z+p}, are extractable by the second phase: $\Delta_{z,q}$. (4) Systems in which AX_{z-q}, AX_z and ZX_{z+q} are extractable by the second phase: Δ. The following relations were obtained:

$$\Delta_{z,p} > \Delta_z, \Delta > {}_{z,q} |\Delta_{z,p}|, |\Delta_{z,q}| > |\Delta_z|, |\Delta|.$$

It was shown that the larger absolute value of $\Delta_{z,p}$ is obtained, the smaller the concentrations of the lower species AX_{z-p} in the first phase of a system. (auth)

41323 ISOTOPE SEPARATION WITH THE MOLECULAR PUMP. O. Boettger and H. Pingel (AEG-Forschungsinstitut, Frankfurt am Main). Vakuum-Tech., 12: 33-7 (Mar. 1963). (In German)

The separating factor and separative power of a molecular pump with simple geometry were calculated. Calculations were made for a pump with two pump-slits: one of them is used for enriching the light component of a binary gas-mixture, and the other for enriching the heavy component. The pump works in such a manner that the input is divided in the two components without rest. The separation of UF_6 is discussed as a numeric example of isotope separation. (auth)

41324 THERMODIFFUSIONAL SEPARATION OF SILICON ISOTOPES IN MONOSILANE. G. G. Devyatikh and G. K. Borisov (Gor'kii State Univ., USSR). Zh. Fiz. Khim., 37: 1985-8(Sept. 1963). (In Russian)

The separation of silicon isotopes by thermal diffusion of monosilane on a coaxial cylinder column with 2 mm gap and a 102 cm long working surface was investigated. The experimental results are in accord with the Johns, Ferry, Onsager theory. The parameters of the ideal cascade for producing 1 g of monosilane per 24 hours, containing the rare isotope in 20% atomic amounts were determined. (auth)

41325 THE SEPARATING POWER OF COMPLEXES WITH RESPECT TO LITHIUM ISOTOPES. D. A. Knyazev and E. V. Sklenskaya (Inst. of Chemistry and Tech., Moscow and Karpov Inst. of Physics and Chemistry, Moscow). Zh. Fiz. Khim., 37: 2094-9(Sept. 1963). (In Russian)

Homogeneous isotopic exchange equilibrium between the aquo complex of lithium and its chelates with nitrilotriacetic, ethylenediaminetetraacetic, and aminobarbituric–N–N-diacetic acids in aqueous solutions was investigated by the ion exchange method. The separation factors are correspondingly: 1.018 ± 0.002, 1.027 ± 0.001, and 1.076 ± 0.004. The chelate complexes become enriched in the Li^6 isotope. The direction of enrichment and the sequence of increasing values of the separating factors are qualitatively explained by the difference in bond strengths of the lithium ion with the functional groups of the chelating agents. (auth)

41326 SEPARATION OF THE ISOTOPES OF LITHIUM. Eiichi Saito (to Commissariat a l'Energie Atomique). U. S. Patent 3,105,737. Oct. 1, 1963. Priority date Apr. 25, 1958, France.

A countercurrent separation process is described in which Li isotope exchange is carried out between Li amalgam and a solution consisting of LiBr or LiCl in dimethylformamide or tetrahydrofuran. (T.F.H.)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 40470, 40472, and 40473.

41327 (HW-SA-3163) APPLICATION OF ELECTRONIC DATA PROCESSING EQUIPMENT TO NUCLEAR MATERIALS ACCOUNTING. J. N. Byland (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Aug. 21, 1963]. Contract [AT(45-1)-1350]. 12p. (CONF-160-3)

From Annual Atomic Energy Commission Contractors Meeting, Nuclear Materials Management, Idaho Falls, Idaho, Oct. 1963.

A mechanized, plant-wide accounting system was developed for nuclear materials. The system is sufficiently flexible to accommodate all existing source and special nuclear material. Provisions were also made to account for additional material which, by direction of the AEC, may be placed in the nuclear material category at some future date. The mechanized system accounts for 12 different materials valued at more than $500 million as they move through a variety of operations such as: production fuels processing, reactor irradiations, chemical separations processes, uranium recovery, and weapons manufacturing. In addition, minor to large quantities of these materials used by research and development organizations in test reactors, fuel development studies, and chemical processing studies are also included. Approximately 16 reports are generated by the computer. (auth)

41328 (TID-19502) GROUP THEORY AND MODERN ANALYSIS. F. R. Haig, T. F. Jordan, and A. J. Macfarlane (Rochester, N. Y. Univ.). Aug. 29, 1963. Contract AT(30-1)-875. 444p.

Mathematical topics from group theory and modern analysis that are of importance in theoretical physics are surveyed. Set theoretic concepts, finite groups, topological concepts and groups, Hilbert space, functional analysis, representation of groups, Lie algebras and groups, and distribution theory are covered. (D.C.W.)

41329 (UCRL-7148-T) THE DEFINITE INTEGRAL OF THE PRODUCT OF LINEAR FUNCTIONS. R. E. von Holdt and R. J. Howerton (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 1962. Contract W-7405-eng-48. 10p.

An exact method of integration applicable whenever the integrand can be represented as the product of n linear functions is described. Two cases are considered: an integrand that is the product of empirically defined functions only and an integrand in which one or more of the factors of the product is analytically defined. (auth)

41330 THE IMMEDIATE HANDLING OF DATA DURING NUCLEAR EXPERIMENTS. Frederic Iselin (CERN, Geneva). Ind. At., 7: No. 7-8, 71-82(1963). (In French)

The problems of data processing during experiments with particle accelerators are introduced. The forms in which the original data are obtained, the recording methods used, and the various ways of processing the data are described schematically. The CERN method of automatic counting, which has great flexibility, is emphasized, and examples with counters and acoustic spark chambers are given. Other transistorized devices are briefly cited: event recorder, voltage programmer, gain stabilizer for a group of measurement devices, and automatic monitor of radioactive samples. Multichannel pulse height analyzers are not dealt with as they are part of well-known standard commercial units. The growth of digital techniques in the realm of nuclear experimentation is shown, and emphasis is placed on the facility and rapidity with which these experiments can be carried out. (tr-auth)

41331 COMPUTERS AND HIGH-ENERGY SECONDARY BEAMS. Jean Fronteau (CERN, Geneva). Ind. At., 7: No. 7-8, 83-95(1963). (In French)

The calculation of a high-energy particle beam is usually reduced to several stages. For several years the different stages were handled by computers. Today the tendency is toward a synthesis, which is described in its logical and historical context. (tr-auth)

41332 A SUM FORMULA FOR GEGENBAUER POLYNOMIALS. Erik Eriksen (Univ. of Oslo). Phys. Norvegica, 1: 121-6(1962).

An infinite bilinear series of Gegenbauer polynomials is considered. A sum formula was found, and the convergence was discussed. A special case of the sum formula was applied to Schrödinger's energy equation in momentum space for a particle in a Coulomb field. The appendix contains a lemma on the convergence of a power series on the circle of convergence. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

41333 (ANL-6677) METALLURGY DIVISION ANNUAL REPORT FOR 1962. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 410p.

Developments made in metallurgy at Argonne National Laboratory are reported. Information is presented on: development and fabrication of materials for EBR-I, EBR-II, Borax-III, Borax-IV, Borax-V, EBWR, and FARET control and fuel element applications; nondestructive testing development; welding developments; properties of reactor materials; corrosion studies; diffusion studies; radiation effects on materials; alloying properties; and metallurgy of basic materials. (N.W.R.)

41334 (ASD-TDR-63-423) SUBMICRON PARTICLE MAGNETS OF IRON AND COBALT. H. M. Fulton (Indiana General Corp. Magnet Div., Valparaiso, Ind.). Apr. 1963. Contract AF33(657)-8499. 39p. (AD-420225)

Submicron particles of Fe, Co, and Co–Fe were made by electrodeposition. A gel of particles and Hg was pressed to form Hg matrix magnets. The magnets were distilled to remove as much Hg as possible; the compacts were impregnated with resins or crushed, mixed with binders, and repressed. PL matrix and oxide-coated particle magnets were also made and studied. Hg matrix magnets were produced with magnetic energy products to 5.8×10^6 gauss oersted. Electron micrographs show that, in contrast to the fine structure of the submicron particles, a gross structure of the arranged particles may be important for determining the overall magnetic properties. (auth)

41335 (ASD-TDR-63-459) OXIDATION-RESISTANT HIGH-TEMPERATURE PROTECTIVE COATINGS FOR TUNGSTEN. H. J. Nolting and R. A. Jefferys (Thompson Ramo Wooldridge Inc., Cleveland). May 1963. Contract AF33(616)-8188. 127p. (AD-418300)

The objective of this program was to develop and apply oxidation resistant high temperature protective coatings on 60 mil tungsten sheet. A series of screening tests, conducted on various tungsten-coating combinations in air at 3300°F, determined that three of the coating composites developed exhibited sufficient potential for more extensive study and evaluation. These coatings were: a co-deposited diffusion alloy of silicon and tungsten; a diffusion alloy composite consisting of titanium, zirconium, and silicon–tungsten deposited in successive cycles; and a diffusion alloy composite of titanium, zirconium–boron, silicon–tungsten deposited in successive cycles. The coated tungsten systems, in the oxidized state, were identified as W+(Si–W)–O, W+Ti–Zr–(Si–W)–O and W+Ti–(Zr–B)–(Si–W)–O. A laboratory scale process for application of each coating system to tungsten by the vacuum pack deposition process was developed and optimized. Oxidation characteristics of the coated systems in air under various static and cyclic conditions were determined from 1600 to 3650°F. Several hours protection was achieved under cyclic conditions as high as 3550°F. Tensile tests on the W+(Si–W)–O and W+Ti–Zr–(Si–W)–O systems were conducted at regular temperature increments from room temperature to 3300°F under various environmental conditions. Tensile properties of uncoated tungsten sheet were determined at the same temperatures under inert atmosphere and vacuum as a basis for comparison. Stress oxidation tests on the W+(Si–W)–O and W+Ti–Zr–(Si–W)–O systems were conducted in air at 3000, 3200, and 3300°F under loads approximating 10 and 20% of the respective system yield strengths. Thermal shock and hot gas erosion tests were also conducted on these coated systems in air at elevated temperatures. Hardness values were determined and reported for the (Si–W)–O and Ti–Zr–(Si–W)–O coatings in the as coated and exposed conditions. X-ray diffraction patterns of the Ti–Zr–(Si–W)–O coating in the as coated, converted (preoxidized), and exposed conditions were made. Calculated "d" spacing values are reported for the phases present in each condition. X-ray diffraction patterns were also made on the (Si–W)–O coating in the as coated condition and after exposure in air. Construction and design of a high temperature oxidation furnace for coating evaluation tests is described. Operation of the furnace at temperatures of 3000 to 3600°F for six week periods without interruption is discussed. (auth)

41336 (EUR-413.f) ETUDE DU CHROME COMME LIAISON METALLIQUE ANTIDIFFUSANTE ENTRE URANIUM ET ALUMINIUM. (A Study of Chromium as a Metallic Bonding Diffusion Barrier Between Uranium and Aluminum). M. Foure, H. Monti, and R. Theisen (Compagnie pour l'Etude et la Réalisation de Combustibles Atomiques, Bonneuil-sur-Marne, France). 1963. 78p.

A choice based upon metallurgical, mechanical, and neutronic considerations demonstrate interest in chromium as a metallic bonding diffusion barrier between uranium and aluminum. The electroplating of chromium on uranium was investigated, and a simple process was developed giving sound and adherent electrolytic depositions. The interdiffusion between uranium and chromium was investigated both between bulk samples of the two pure metals or their alloys and on electrolytic depositions. Interdiffusion between chromium and aluminum was studied on small-scale chromium-plated uranium elements with A5 type aluminum canning and heat treated under various conditions of time, temperature, and pressure. The composition of the various zones of diffusion was determined by means of an electron microprobe, specially in the case of the total consumption of the chromium barrier where a ternary diffusion U–Cr–Al occurs. Several tests of thermal cycling were run on small-scale fuel elements in an attempt to prove the behavior of the electrolytic deposition of chromium and the resistance of the bonding between the core and the can. (auth)

41337 (GA-4260) COATED-PARTICLE-FUELS RESEARCH AT GENERAL ATOMIC FROM NOVEMBER 1, 1962 THROUGH MAY 31, 1963. Walter V. Goeddel and Lloyd R. Zumwalt, eds. (General Atomic Div. General Dynamics Corp., San Diego, Calif.). June 3, 1963. Contract AT(04-3)-167. 68p. (CONF-273-1)

From 5th Meeting of the Coated Particle Fuels Working Group, Cincinnati, June 1963.

Measurements of the rate of migration of uranium into pyrolytic-carbon coatings on uranium dicarbide particles were made over the temperature range 1700 to 2500°C using microradiographic techniques. Migration coefficients and activation energies were calculated from these data. The conditions under which a graphite matrix containing carbide particles can be hot-worked without adversely affecting the particles, so that improved properties of hot-worked

graphite can be realized in the immediate neighborhood of the carbide particles, were analyzed and summarized. The fission-product release from spherical monocrystalline uranium dicarbide particles was studied by means of post-irradiation annealing of neutron-activated samples and by exposing samples to a steady rate of photofission using 30-Mev x-rays from an electron accelerator. The rate of migration of uranium in pyrolytic graphite was determined at 1600 to 2200°C. Fission gas release in the in-pile loop installed in GETR was measured during the testing of pyrolytic-carbon-coated fuel particles. (N.W.R.)

41338 (GA-4391) INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS. Quarterly Progress Report for the Period Ending May 31, 1963. (John Jay Hopkins Lab. for Pure and Applied Science. General Atomic Div., General Dynamics Corp., San Diego, Calif.). Sept. 25, 1963. Contract NAS 3-2532. 98p.

Two long-term test cells were fabricated and tested. One was loaded with a 30 UC–70 ZrC sample and the other with a 90 UC–10 ZrC sample. The rates of vaporization of these samples in vacuum were determined both in the absence and in the presence of a Ni anode maintained at 983°K with an electrode spacing of 20 mils, in order to set the baseline values. Measurement of the rates of vaporization of these samples under these conditions in the presence of Cs vapor at a pressure of about 1.8 torr are in preparation and will be continued for 1000 hr. Operation of the first test cell, containing the 90 UC–10 ZrC emitter, was terminated after 510 hr because of leakage through a faulty metal gasket sealing the electron-gun compartment. The second test cell, containing a vapor-deposited W-clad UC emitter, was assembled and operated for a period of 111 hr. The test was terminated because a leak developed between the cell compartment and the electron-gun compartment. A control cell containing a solid W emitter is being assembled to check the modifications made in the design of the electron-gun chamber and the filament in order to overcome such difficulties. Components for four other test cells were received. Fabrication of the emitters for these cells was partially completed. Measurements were completed on the vacuum vaporization rates of two cold-pressed and sintered 30 UC–70 ZrC samples (B_1-9 and B_1-9a) at 2073 to 2273°K, and of a cold-pressed and sintered 90 UC–10 ZrC sample (B_1-10) at 2013 to 2085°K. The vacuum emission of B_1-9 at 1700 to 2000°K and its open-pore fraction were also determined. The results are compared with those obtained on other UC–ZrC samples. Physical redeposition studies were made in cases such as UC (2015 to 2083°K) with Ni anode at 558 to 983°K, 90 UC–10 ZrC (2027 to 2038°K) with Ni anode at 983°K, and 30 UC–70 ZrC (2082 to 2123°K) with Ni anode at 983°K. The activation, poisoning, and regeneration of the vacuum emission of a hyperstoichiometric UC sample were studied at 1670 to 2000°K. The high-temperature furnace, with the sample loading and testing fixtures in position, was tested at 2073°K. Minor mechanical difficulties encountered were corrected. The bearing guiding the loading rod was shifted to a cooler region of the furnace to avoid freezing of the rod by the bearing when the furnace is at a high temperature. The vacuum emission of the stoichiometric $UMoC_2$ sample (D_1-2) was measured at 1750 to 2000°K. The rate of vacuum vaporization of a cold-pressed and sintered 30 UC–70 NbC sample (D_1-3) was determined at 2050 to 2198°K. The compatibility between 98 wt% W–2 wt% Mo alloy and UC–ZrC (90 UC–10 ZrC and 30 UC–70 ZrC) was studied at 2073°K for a period of 24 hr (Run D_2-4). The diffusion samples after Runs D_2-1 (Ir, Re, and W-26Re versus UC), D_2-2 (85 wt-% W–15 wt-% Mo versus UC), and D_2-3 (98 wt-% W–2 wt-% Mo versus UC) were examined by electron-microprobe techniques. Electron-microprobe studies were made on the vapor-deposited W-clad hyperstoichiometric UC (5.02 wt% C, sample D_3-1) after it was subjected to diffusion-emission studies at 2073°K for a period of 838 hr. Two carbide samples, one hypostoichiometric UC (4.70 wt% C, sample D_3-2) and the other 30 UC–70 ZrC (sample D_3-3) were clad with vapor-deposited W and will be subjected to similar studies. (auth)

41339 (GE-62FPD365) EVALUATION OF A HIGH-STRENGTH COLUMBIUM ALLOY (AS-55) FOR ALKALI METAL CONTAINMENT. Interim Report, November 25, 1961–July 25, 1962. R. G. Carlson, D. N. Miketta, R. G. Frank, and J. W. Semmel, Jr. (General Electric Co. Spacecraft Dept., Cincinnati). Contract NAS-3-2140. 204p.

Fourteen 6 to 12-pound arc-cast ingots of AS-55 niobium alloy were melted to establish the melting characteristics of the alloy and to provide material for TIG welding, mechanical properties (especially long time stress-rupture properties), and potassium corrosion investigations. In general, all of the ingots melted for the program under a rather wide range of conditions were considered to be of high quality. The alloy is considered to be highly weldable, and post-weld heat treatments of 2200 to 2400°F were effective in retaining excellent low-temperature (–100°F) weld bend ductility after 100-hour aging treatments in the temperature range 1400 to 1800°F. Considerable contamination by oxygen and carbon was found to occur in stress-rupture specimens after 1000 hours of testing at 2200°F in cold wall, uncold trapped, oil diffusion pumped vacuum chambers at pressures of 3×10^{-6} torr. Short-time tests (< 100 hours) indicate the material to have similar rupture properties to those determined for material produced previously. Potassium corrosion reflux capsule tests were conducted on AS-55 and Nb–1Zr alloys at 2000 and 2200°F for 1000 and 250 hours, respectively. The tests were run in getter-ion pumped vacuum chambers at pressures of 10^{-6} torr. Five- and ten-thousand hour 2000°F capsule tests of AS-55, D-43, and Nb–1Zr are currently underway. (auth)

41340 (GEMP-27A) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT No. 27, PART A. (General Electric Co. Advanced Technology Services, Cincinnati). Sept. 30, 1963. Contract AT(40-1)-2847. 50p.

Progress in development programs is presented in sections on high-temperature reactor-materials fabrication research and effect of radiation on high-temperature alloys. Separate abstracts were prepared for each section. (J.R.D.)

41341 (GEMP-27A(p.9-24)) HIGH-TEMPERATURE REACTOR MATERIALS FABRICATION RESEARCH. (General Electric Co. Advanced Technology Services, Cincinnati).

A 1000-hour test of arc-cast Mo at 2200°C in H_2 was completed. The sample did not perform as predicted by analysis of 10- to 100-hour stress-rupture data; the cause for the unusual behavior was identified. Additional stress-rupture and creep tests of sintered W-25Re (wt %) were performed. The mechanical property data accumulated during the past year were condensed and are presented in the form of 1-hour and 10-hour isochronal plots. (auth)

41342 (GEMP-27A(p.25-48)) EFFECT OF RADIATION ON HIGH-TEMPERATURE ALLOYS. (General Electric Co. Advanced Technology Services, Cincinnati).

Stress-rupture and creep properties of W–25Re flat specimens irradiated at reactor ambient temperature to a dosage of approximately 8×10^{18}nvt ($E_n \geq 1$ Mev) were measured at 1100°C. Although the rupture life of the irradiated specimens was not significantly changed when compared with control specimens, there was a consistent lowering of the creep rate of irradiated specimens. Based on one pair of tests, it appears that Re irradiated to approximately 8×10^{18}nvt ($E_n \geq 1$ Mev) and tested at 1100°C has a lower creep rate and a slightly longer rupture life than an unirradiated specimen tested at 1100°C. Both the control and the irradiated Re specimens exhibited a relatively short third stage creep period. W specimens irradiated at reactor ambient temperatures to a dosage of about 3.7×10^{18}nvt ($E_n \geq 1$ Mev) and tested at 1100°C show a slight increase in rupture life. This material also has an initial incubation time period of approximately 10 min prior to the start of the normally observed primary creep. In addition, the minimum creep rate was not significantly changed when compared with control specimens. Specimens irradiated to a higher dosage (2.5×10^{19}nvt), however, exhibited a reduction in minimum creep rate by a factor of about two and an increase in rupture life by a factor of about 2.6 when compared with control specimens. As in the case of the lower irradiation, the typical primary stage creep was not observed. The incubation time period prior to the start of the characteristic secondary stage of creep was about 1 hour. Annealing of irradiated specimens (2.5×10^{19} nvt) at 1400°C for 1 hour prior to creep-rupture testing at 1100°C did not change the minimum creep rate or significantly reduce the rupture life when compared with the as-irradiated (2.5×10^{19} nvt) specimen. This annealing treatment, however, did remove the anomalous initial creep behavior and restored the typical primary stage of creep which is characteristic of unirradiated specimens. Isochronal annealing studies on irradiated W specimens demonstrated that increases in resistivity because of irradiation may be mostly annealed out in three stages which are prominent at about 16, 22, and 31% of the absolute melting temperature of W. For higher irradiations, some of the radiation-induced resistivity still remains after 1 hour anneals at temperatures above 1630°C. Irradiated ($\sim 5 \times 10^{19}$ nvt, $E_n \geq 1$ Mev) A-286 specimens containing the least amount of B (0.00085%) show the greatest reduction in rupture life when compared with corresponding control specimens. Specimens containing 0.01% natural B did not show significant change in rupture life because of irradiation, although the ductility was significantly lowered in both high- and low-B-containing irradiated specimens. A-286 specimens irradiated at 690°C to a dosage of approximately 4×10^{19} nvt ($E_n \geq 1$ Mev) and tested at 650°C show a significant increase in fatigue life when compared with control specimens. There also appears to be a stress range where the observed change approaches a minimum. (auth)

41343 (HW-74938) SPECIFICATIONS FOR HIGH TENSILE STRENGTH CARBON–SILICON STEEL A212 GRADE B PLATE. T. T. Claudson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 12, 1962. Contract AT(45-1)-1350. 5p.

A specification is presented for A212 Grade B C–Si steel plate specimens for irradiation testing. The specification includes process, heat treatment, chemical analysis, tensile properties, impact properties, fabrication, inspection, and marking. (D.L.C.)

41344 (HW-74939) SPECIFICATION FOR MANGANESE–MOLYBDENUM STEEL A302 GRADE B PLATE. T. T. Claudson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 12, 1962. Contract AT(45-1)-1350. 4p.

A specification is presented for Mn–Mo steel A302B plate specimens for studies of the effects of neutron irradiation on the mechanical and physical properties. The specification includes process, heat treatment, chemical analysis, tensile properties, impact properties, fabrication, inspection, and marking. (D.L.C.)

41345 (HW-74960) SPECIFICATION FOR AGE-HARDENABLE NICKEL–CHROMIUM–IRON ALLOY IN PLATE, SHEET, AND STRIP. T. T. Claudson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 17, 1962. Contract AT(45-1)-1350. 15p.

A specification is presented for plate, sheet, and strip specimens of age-hardenable Ni–Cr–Fe alloy for irradiation testing. The specification includes conditions and finishes, process of manufacture, chemical composition, analysis, mechanical properties, grain size, fabrication history, permissible variation and dimensions, identification, workmanship, packing, inspection, certification, and rejection. (D.L.C.)

41346 (HW-74961) SPECIFICATION FOR NICKEL–CHROMIUM–IRON ALLOY IN PLATE, SHEET, AND STRIP. T. T. Claudson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 14, 1962. Contract AT(45-1)-1350. 14p.

A specification is presented for Ni–Cr–Fe alloy plate, sheet, and strip products to be used in irradiation testing. The specification includes conditions and finishes, process of manufacture, chemical composition, analysis, mechanical properties, grain size, fabrication history, permissible variations and dimensions, identification, workmanship, packing, inspection, certification, and rejection. (D.L.C.)

41347 (HW-75208) SPECIFICATION FOR TYPE AM 355 ALLOY. T. T. Claudson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash). Oct. 9, 1962. Contract AT(45-1)-1350. 8p.

A specification is presented for type 355 alloy plate, sheet, and strip products to be used in irradiation testing. The specification includes conditions and finishes, process of manufacture, heat treatment, chemical composition, analysis, mechanical properties, grain size, fabrication history, identification, workmanship, packing, inspection, certification, and rejection. (D.L.C.)

41348 (HW-75477) SPECIFICATION FOR AUSTENITIC STAINLESS STEEL PLATE, SHEET, AND STRIP TYPES 304 AND 348. T. T. Claudson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1, 1962. Contract AT(45-1)-1350. 9p.

A specification is presented for types 304 and 348 austenitic stainless steel plate, sheet, and strip to be used in irradiation testing. The specification includes process, heat treatment, chemical composition, analysis, finish, mechanical properties, bending properties, grain size, testing, retreatment, workmanship, marking, inspection, certification, and rejection. (D.L.C.)

41349 (HW-SA-3046) CONTINUOUS ELECTROWINNING OF PLUTONIUM FROM CHLORIDE MELTS. Martin H. Curtis (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 12, 1963. Contract AT(45-1)-1350. 20p. (CONF-202-2)

From the Electrochemical Society Fall Meeting, New York, Sept. 1963.

Continuous electrowinning of plutonium metal from plutonium trichloride was successfully demonstrated in nuclearly safe equipment. Nuclear safety is achieved by restricting the system in a 57 mm diameter envelope. Operation is on a 50-gram per hour scale, with a 60 percent cathode current efficiency. The molten system consists of 30 wt % plutonium chloride, 28 wt % barium chloride, and 42 wt % potassium chloride. The system has the capability of handling some oxide in the plutonium chloride feed and to remove feed impurities that form low-boiling chlorides. Attainable product purity is limited primarily by the impurities in the feed. Basis for continuous operation is a cell with provision for metal product under flow. Slip cast ceramic oxide cells and inductive heating are used to permit rapid attainment of the operating temperature of 800°C. Best results are obtained when the operation is not interrupted, but maintained as steady as possible. Runs up to 10 hours' duration were made and prospects for runs of several days' duration are possible. Conditions were established for practical operation. (auth)

41350 (MLM-1162) REACTOR FUELS AND MATERIALS DEVELOPMENT PLUTONIUM RESEARCH, APRIL–JUNE 1963. L. J. Wittenberg (Mound Lab., Miamisburg, Ohio). June 30, 1963. Contract AT(33-1)-Gen-53. 22p.

A solid-solution alloy of 10 at.% Pu in Y was produced as microspheres by passing powdered particles of the alloy through the induction-coupled plasma torch. This alloy is one of the few solid-solution alloys of Pu which melt above the melting point of Pu metal. The microspheres have potential application as the fissile particles in dispersion type fuels. Unlike pure Pu the shiny particles retained their original appearance on continuous exposure to laboratory air. Metallographic examination of cross-sectioned microspheres indicated a uniform single phase, the solid solution. Metallographic work on the Ce–Pu binary system was completed. Metallographic specimens which were annealed and quenched were analyzed with the electron probe to determine the limits of solid solubility at the two ends of the binary system. The maximum solubility of Ce in epsilon Pu is 16 at.% at 626°C. Delta Pu forms by peritectoid reaction at 613°C. Ce is soluble in delta Pu to about 23 at.% Ce at this temperature and decreases to 17.5 at.% at room temperature. The maximum solid solubility of Pu in gamma Ce is 34.5 at.% Pu at 626°C decreasing to less than 10 at.% at room temperature. The solubility of Pu in delta Ce is 19.5 at.%. Quenching studies showed no evidence of recurrent melting in the region from 75 to 85 at.% Ce. The viscosity of a Pu–1 at.% Fe alloy decreased with increasing temperature from 6.5 centipoise at its melting point (628°C) to 4.3 centipoise at 905°C. The 1 at.% (0.234 wt %) Fe addition to the pure Pu metal raised its viscosity an average of 5% the measured temperature interval. Electromotive force measurements are being conducted on liquid metal alloys so that an apparatus can be developed for the determination of the same thermodynamic properties for Pu alloys. Electromotive force measurements were conducted on a series of Cd–Bi alloys at 500°C using fused salt bridges. The heat capacity of a Pu–Ce–Co eutectic alloy was measured at a 100 to 600°C. Since the melting point of the alloy was 424°C, several measurements were made in the liquid range. The heat capacity values increased almost linearly with temperature from 5.8 to 11.0 calories per mole per °C. No abrupt change in the heat capacity was noted at the melting point. The heat required to melt the alloy at the melting point was determined to be 1630 ± 20 calories per mole. The feasibility of producing PuO_2–ThO_2 solid solutions by plasma torch techniques was demonstrated. The spheroidized product, composed of equal parts of the two oxides, ranged in diameter from 10 to 150 microns. The transparent yellow microspheres were shown by x-ray-diffraction to be a single-phase solid solution. A cubic crystal of PuO_2 formed in a melt of PuO_2 dissolved in silicate glass. The crystal was trapped in a glass fiber drawn from the melt and was examined by crystal x-ray analysis. The analysis showed a nearly perfect face-centered cubic single crystal with a lattice parameter a = 5.397 A. Precise lattice parameters of the crystal and the x-ray scattering factors for Pu are being obtained. ZrO_2 is being studied as a nonfissile diluent for PuO_2 in potential reactor fuels. The ZrO_2 microspheres, produced as powder is passed through the induction-coupled plasma torch, are being characterized by x-ray-diffraction techniques. Diffraction photographs of microspheres which had been ground to a powder revealed that the product was the monoclinic form of ZrO_2, which is the stable form below 1100°C. Single crystal analysis of one microsphere, however, revealed a tetragonal lattice with parameters of a = 3.64 A and c = 5.24 A. The tetragonal form of ZrO_2 with which this form compares in lattice parameters, is stable only above 1000°C. A method was developed for determining microgram quantities of Ni in Pu alloys. Ni was extracted as nickel dimethylglyoxime. Interference was investigated in this spectrophotometric method. The pH of the solution was raised to 10.0 prior to color development in order to stabilize the complex for a period long enough to obtain absorbance readings. An accurate method is being developed for the determination of Pu in Pu–Cu–Ce alloys. Pu(IV) was reduced in a Jones reductor and plated on an electrode. High results were obtained as a result of electrode poisoning. A titration of the starting solution indicated that 90% of the Pu was present in oxidation state III. (auth)

41351 (NAA-SR-8361) ROLE OF PHOSPHORUS IN GROWTH OF BERYLLIA SINGLE CRYSTALS. S. B. Austerman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 30, 1963. Contract AT(11-1)-Gen-8. 16p.

The growth of beryllia single crystals from lithium molybdate flux has been described previously. With lithium phosphate added to the flux in amounts up to several percent, unique crystal habit modifications occur, the extent of modification depending upon temperature, flux composition, and phosphate concentration. Also, the temperature for crystal nucleation is slightly lowered, and generation of inclusions, otherwise severe, is markedly suppressed. Phosphorus is not introduced into the crystal from the flux in significant amounts. (auth)

41352 (NMI-1259) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. DEVELOPMENT OF URANIUM-BASE ALLOYS STRENGTHENED BY SLIS TECHNIQUES. Summary Technical Report to the United States Atomic Energy Commission for the Period July 1, 1962 through June 30, 1963. A. L. Geary (Nuclear Metals, Inc., West Concord, Mass.). Oct. 4, 1963. Contract AT(30-1)-2784. 46p.

New improved uranium-base alloys are developed by the SLIS technique in which dispersions are achieved with metallic particles rather than oxides. The alloying elements are highly insoluble in the solid state and, thus, have little tendency to agglomerate (over-age) at elevated temperatures. Uranium-copper SLIS alloys were prepared by dissolving copper in liquid uranium and then quenching rapidly. Examination of an as-quenched alloy at magnifications up to 20,000× failed to reveal any precipitate; after

compaction at 600°C, particles having an average diameter of 0.08 micron and a concentration of 7×10^{13} per cubic centimeter were observed. Aging to 500 hours at 800°C produced only a moderate increase in particle size. (auth)

41353 (NMI-2120) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report to the United States Atomic Energy Commission for the month of August, 1963. (Nuclear Metals, Inc., West Concord, Mass.). Oct. 21, 1963. Contract AT(30-1)-2784. 25p.

Progress was achieved in the development of methods for the extrusion and drawing of tungsten tubing. Fabrication and properties of the drawn and extruded tungsten tubes are outlined. The effects of iron and silicon additions on the mechanical properties of zone-refined beryllium crystals are evaluated. The most significant conclusion is that iron at about the 1000 ppm level in the absence of other impurities is beneficial to deformation behavior. There appears to be some sacrifice in ductility at the 100 ppm iron level. Silicon up to 350 ppm in the absence of iron appears to have little effect on deformation behavior other than basal work hardening. Compression tests on beryllium are reported and the results show slip, twinning, and fracture. Fabrication of splat-cooled copper-uranium and beryllium-uranium alloys for metallographic examination and mechanical testing is discussed. (N.W.R.)

41354 (NP-13158) A STUDY OF SELECT CERAMIC OXIDE COMPOSITIONS AS HIGH TEMPERATURE (1600-2100°K) THERMAL ENERGY STORAGE MATERIALS. Final Report, February 1962 to February 1963. E. F. Batutis (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). May 7, 1963. Contract NAS5-826. 97p.

An investigation of select ceramic oxide mixtures was conducted which included corrosion, materials testing, and the development of a thermal conductance apparatus. This apparatus was designed to measure the thermal conductance of these oxide mixtures through their melting temperatures (as high as 2200°K). The combinations of materials studied were: 3BeO–2CaO (1685°K) with Mo, Mo–Re, W, and W–Re; Al_2O_3–4BeO–4MgO (1910°K) with Mo, Mo–Re, W, W–Re, and Re; Al_2O_3–4BeO–MgO (2020°K) with Mo and W; and 3BeO–2MgO (2145°K) with W, W–Re, and Re. All but a few of the failures in the containers were caused by poor welds or excessive grain growth. Analyses show good chemical compatibility between oxide mixtures and the refractory metals. Corrosion rate calculations based on the limited data indicate 2-4 mils loss in 10,000 hours for the best combinations. The thermal conductance apparatus was fabricated, installed, and calibrated. Calibration data are presented. The oxide specimen container geometry is rather difficult to fabricate and requires techniques to insure no voids in the oxide melt as well as to keep parasitic heat losses to a minimum. (auth)

41355 (NP-13168) EPITAXIAL GROWTH: AN ANNOTATED BIBLIOGRAPHY. Helen M. Abbott and James V. Kerrigan, comps. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Apr. 1963. 77p. (SB-63-32)

Supplement to reports, SRB-61-7 and SRB-62-3.

This compilation contains 169 selected references and a preface on epitaxial crystal growth. Included are such factors as crystal growth and formation, vapor growth, twinning, and thin film processes. An index is included as an aid in locating specific materials and authors. These references supplement the preceding bibliographies on Epitaxial Growth; LMSC-SRB 61-7 (AD-253 404) and LMSC-SRB 62-3 (AD-275 588). (auth)

41356 (NP-13184) A PORTFOLIO OF EXPERIENCE IN REFRACTORY METAL PROTECTIVE SYSTEMS. D. H. Leeds (Aerospace Corp., El Segundo, Calif.). Mar. 11–14, 1963. 389p.

This report supersedes Report TDR-169(3240-31) TR-1, "Re-Entry Protective Systems: A Bibliography of Refractory Metals Protective Systems Research," published 6 August 1962. The purpose of the present document is twofold: to direct research in the field of refractory metals protective coatings away from present silicide approaches and into systems capable of protection over 3500°C, and to familiarize the materials engineer with past and current research in his field (including the valuable examples set by silicide protection theory), thereby enabling him to interpret his own science for the designer. The report is divided into five major sections: molybdenum (366 references); columbium (299 references); tungsten (497 references); tantalum (229 references); and a new section, general (2401 references), which contains references to oxidation testing of refractory metal systems and to areas of research allied to the one vital problem, the protection of these metals from unfavorable environments at elevated temperatures. (auth)

41357 (NUMEC-P-62) DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS. Monthly Progress Letter, August 1963. Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Penna.). Sept. 10, 1963. Contract AT(30-1)-2389. 5p.

All PuO_2, UO_2, and PuO_2–UO_2 powders required for the fabrication of the high burnup irradiation specimens were prepared, and these powders are now being characterized. Detailed fuel element and irradiation capsule design studies are underway, and heat fluxes and central fuel temperatures are being determined for GETR RAFT facility flux conditions. Sintering studies are being continued to study Pu_2O_3 formation in UO_2–PuO_2 compositions and also to determine reduction-oxidation characteristics of these materials. (N.W.R.)

41358 (NUMEC-P-105) DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS. Progress Report, April 1–June 30, 1963. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Contract AT(30-1)-2389. 39p.

Tables are presented of the conditions used in the preparation of PuO_2, and of the characteristic data of the PuO_2 powders obtained thereby. UO_2–PuO_2 coprecipitation runs, which resulted in powders of improved sinterability, are reported. Studies are being made on the preparation of UO_2–PuO_2 powders by wet ball milling of the component powders. Sintering studies of PuO_2 and UO_2–PuO_2 powder compacts are reported. Studies of oxidation kinetics of UO_2–PuO_2 are continuing. Results of compatibility and corrosion studies on UO_2–PuO_2 pellets are described briefly. The status of short-term and high-burnup irradiation tests is outlined. (D.L.C.)

41359 (SC-DC-3436) VAPOR PLATING OF BERYLLIUM, URANIUM, AND THORIUM. A BIBLIOGRAPHY. Ida Mae Gutierrez, comp. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1963. Contract AT(29-1)-789. 9p.

A bibliography of 57 references is presented which is arranged into the following sections: General, Properties, and Procedures. The period covered is from 1952 to 1961. (D.L.C.)

41360 (UCRL-7178) THIN FILMS OF BeO AND OTHER SINTERABLE MATERIALS. J. S. Kahn and J. B.

Cahoon, Jr. (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 24, 1963. Contract W-7405-eng-48. 9p.

A procedure is described for the direct preparation of films of BeO, thin enough for the study of dislocations. The procedure consists of placing a slurry of BeO on an electron microscope grid made of tungsten. The slurry is sintered on the grid at some satisfactory temperature, then cooled and transferred directly to the electron microscope for study. It is felt that this procedure is applicable to most any sinterable material. (auth)

41361 (UCRL-7245) STUDIES ON THE DEVELOPMENT OF MICROCRYSTALS OF BeO. Herbert W. Newkirk and Deane K. Smith (California. Univ., Livermore. Lawrence Radiation Lab.). May 20, 1963. Contract W-7405-eng-48. 40p. (CONF-280-1; CONF-281-1)

From International Union of Crystallography 6th General Assembly, Rome, Sept. 1963 and International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Beryllium oxide (BeO) microcrystals were grown by (1) oxidation of beryllium in wet hydrogen at 1525°C, (2) water-vapor attack on polycrystalline BeO at 1525°C, and (3) from lead fluoride (PbF_2)–BeO mixtures at 925°C. The microcrystals are of two types, whiskers and platelets. Three types of whiskers were observed, depending on whether the growth direction is [00·1], [1$\bar{1}$·0], or [10·0]. The first type is the most common, and in the presence of PbF_2 it is the only type observed. The larger whiskers of this type are often hollow, but electron microscopy does not verify the existence of cores in the smaller ones. Water vapor attack produces all three types of whiskers. The [10·0] type is very rare and was not observed among whiskers grown epitaxially on single crystal substrates. Epitaxially grown whiskers are similar to the smaller as-grown whiskers and do not contain pores, are not twisted, and appear smooth at magnifications to 100,000×. Whiskers obtained from PbF_2–BeO mixtures are sometimes as long as 10 cm, can be stressed to 3,000,000 lb/in^2 in bending, and elastically strained 4.5%. Axial growth rates were 0.1 micron per second in methods (1) and (2) and 0.4–1.3 microns per second in method (3). Platelets are of three types formed by growth along the combinations of two of three whisker directions. The most common platelets are the [00·1]–[1$\bar{1}$·0] type. Twinning was frequently observed with either the (11·2) or the (10·3) as the twin plane. The relationship of the structures across the twin boundaries and their strong tendency to twin on these planes was interpreted with respect to the polar crystal structure and is discussed in detail. (auth)

41362 (UCRL-10611) GLASS-METAL "INTERFACES" AND BONDING. Joseph A. Pask (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley). Jan. 3, 1963. Contract W-7405-eng-48. 65p.

A theory on glass-metal bonding is developed and discussed. The theory states that chemical bonding occurs at the glass-metal "interface" when there is a balance of bond energies, which is achieved when thermodynamic equilibrium exists. This "interface" consists of a transition zone that includes an intermediate "-ous oxide layer," which can be monomolecular in thickness. This layer must be in thermodynamic equilibrium with the glass at the interface and also with the metal at the interface. The development of these conditions is discussed for the examples of iron, gold, and platinum in contact with sodium disilicate. The significance of sessile-drop experiments and strength measurements of glass-metal seals are also discussed. The steps taken in making glass-metal seals are briefly covered. (auth)

41363 (WADD-TR-60-646(Pt.II)) CARBONIZATION OF PLASTICS AND REFRACTORY MATERIALS RESEARCH. J. A. Coffman, G. M. Kibler, T. F. Lyon, and B. D. Acchione (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Aug. 1961. Contract AF33(616)-6841. 183p. (AD-297946)

Presented are the results of continuing investigations of the Carbonization of Plastics, Vapor Pressure of Refractory Materials, and Spectral Emmissivity of Refractories. Studies of thermal degradation of phenolic, epoxy, polyphenylene, and polynaphthalene resins were made with the arc-image furnace, the fluidized bed reactor, and the thermogravimetric analysis technique. The effect of semicarbonized materials used as fillers has been studied and a Bendix time-of-flight mass spectrometer has been adapted to the study of transient and stable species resulting from the flash-photolysed degradation of plastics. Properties of carbon residue have been measured. Vapor pressure studies using the Langmuir evaporation technique, the matrix isolation method, and resonance line absorption spectroscopy have progressed. Rates of evaporation of tungsten carbides, hafnium carbide, and titanium carbide have been measured; further conclusive measurements on zirconium carbide have been made. Preliminary application of the matrix isolation technique to thoria has been made. Resonance line absorption studies have been completed on zirconium carbide and titanium carbide and the accessible thermodynamic data have been deduced. Normal spectral emissivities of W-2 coated molybdenum, siliconized ATJ graphite, tantalum, molybdenum, tungsten carbide, and zirconium have been measured in the temperature range of 1400 to 3100°K. (auth)

41364 (EURAEC-562) STUDY OF THE SHAPING AND IRRADIATION OF URANIUM MONOCARBIDE. Quarterly Report No. 8, October 1–December 31, 1962. (France. Commissariat a l'Energie Atomique, Paris). Mar. 26, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 080-62-3-RDF. 54p. (A translation)

The first fuel element irradiations in Melusine were started. The device for the out-of-pile heat treatment of uranium monocarbide rings, identical to those of the first irradiation in EL-3, was put in service. The design study and fabrication of special fuel elements for irradiation in the EL-3 lattice up to a burn-up of 6000 Mwd/t with temperatures at 1000, 1500, and 2000°C were continued. The fabrication and thermal properties of zirconium monocarbide made by sintering under load, were evaluated for use as a refractory sleeve for the irradiation device. The production of enriched uranium carbide rods by fusion under electronic bombardment was accomplished to ensure the study of irradiated fuels insofar as their thermal and electric conductivity is concerned, as well as the micrographic examination and x-ray diffraction. (auth)

41365 (EURAEC-645) THE SHAPING AND IRRADIATION OF URANIUM CARBIDE. Quarterly Report No. 9, January 1, 1963–March 31, 1963. (France. Commissariat à l'Énergie Atomique, Paris). Apr. 25, 1963. Work Performed under United States–Euratom Joint Research and Development Program. 18p. (A translation)

The first irradiation in Melusine is going satisfactorily. A break in a heater element after 610 hours of irradiation reduced the temperature to 500°C, testing at this tempera-

ture will be continued. Following an out-of-pile heat treatment, it is noted that irradiation has nothing to do with the growth of the uranium carbide grain irradiated to 700 Mwd/t in EL-3 at 550°C. The first irradiation test made on EL-3 slug for 10% enriched uranium carbide rings led to the modification of the potassium-sodium safety device. Fission gas extraction is found to be more reproducible from uranium carbide monocrystals prepared by fusion under electron bombardment. The preparation of uranium powder and uranium carbide is discussed. Measurement of electric and thermal conductivity of uranium carbide after irradiation is also discussed. The thermal conductivity of Armco iron is evaluated. (N.W.R.)

41366 (EURAEC-664) PLUTONIUM RECYCLING. Quarterly Report No. 9, January–March 1963. (France. Commissariat à l'Énergie Atomique, Paris). Work Performed under United States–Euratom Joint Research and Development Program. 13p. (A translation)

The production of the first run of reconstituted plutonium–uranium fuels for treatment in the critical Aquilon Marius reactors is being accomplished at the Cadarache plant. The plutonium content of the rods is being checked by a neutron method. The development of detectors is discussed. (N.W.R.)

41367 (EURAEC-711) OXIDATION OF SINTERED URANIUM DIOXIDE AND MICROGRAPHIC CHARACTERIZATION OF EXCESS OXYGEN. Special Report No. S 6, January 1 to December 31, 1962. M. Brandela and R. Delmas (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Cadarache). Work Performed under United States–Euratom Joint Research and Development Program. 38p. (CONF-193-4). (A translation)

From 8th Nuclear Congress, Rome, June 1963.

Thermogravimetric and micrographic studies were carried out on the effects of H_2–0.5% O_2 on UO_2, oxidation of sintered UO_2 by water vapor, superstoichiometric sintered UO_2, measurement of O/U ratio, reoxidation of sintered UO_2 at low temperatures, and control of industrial sintered UO_2. The results show that H_2–0.5% O_2 is a reducing agent above 420°C and an oxidizing agent below that point, and the slight oxidation corresponding to a stoichiometry of $UO_{2.001}$ may be detected by micrographic examination of the surface. (D.L.C.)

41368 (EURAEC-784) TESTS ON ZIRCONIUM HYDRIDE IN ZIRCALOY-2 AND ZrNb ALLOYS. Quarterly Report No. 7, April 1–June 30, 1963. (Siemens-Schuckertwerke A. G., Erlangen, Germany). Work Performed under United States–Euratom Joint Research and Development Program. Contract 024-61-1ORDA. 27p. (A translation)

The effects of hydrogen content on the mechanical properties of Zircaloy-2 and niobium-zirconium alloys were determined. The corrosion of copper-molybdenum-zirconium alloy and copper-niobium-zirconium alloy by superheated steam at 500°C and one atmosphere was measured and the uptake of hydrogen from the reactions was determined. Metallographic investigation and comparisons of hydride precipitations in corroded and hydrogenated specimens of niobium-zirconium alloys were made. (N.W.R.)

41369 (EURAEC-790) USE OF PLUTONIUM AS A FUEL IN NUCLEAR REACTORS. Quarterly Report No. 11, April 1–June 30, 1963. (Brussels. Centre d'Étude de l'Énergie Nucléaire and Société Belge pour l'Industrie Nucléaire, Brussels). July 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 096-62-12-RDB. 68p. Translation of BN-6307-03.

The crystal structure of precipitated Pu peroxide, oxalate, and hydroxide are reported. Sintering studies show that for PuO_2, the density is at a maximum for calcination at low temperatures and that for UO_2–PuO_2, PuO_2 diffuses slowly into UO_2 and dissolves some of the UO_2. Improved densities after vibration filling and swaging of the tubes with PuO_2 are reported. The electrochemical detetermination of Pu and the checking of leaks and Pu distribution in fuel elements are considered. The thermal conductivity of UO_2 fuel units was found to increase during thermal cycling owing to the formation of basaltic structure. A thermal simulation test on a UO_2–2% PuO_2 fuel unit did not reveal any evidence of preferred Pu diffusion. The characteristics of UO_2–PuO_2 samples being irradiated are tabulated. A thermal simulation test was made on a U carbide fuel unit to determine its thermal conductivity. Plutonium dissolution and purification in Pu recycling are discussed. (D.L.C.)

41370 (NP-tr-1066) INVESTIGATION OF HEAT-RESISTANT ALLOYS. I. P. Bardin, G. V. Kurdyumov, et al., eds. Translated from Issled. po Zharoproch. Splavam, Akad. Nauk SSSR, Inst. Met., 3: 1-430(1958). 728p.

A book containing 46 papers on the properties and structure of heat-resistant alloys is presented. (N.W.R.)

41371 STUDY OF THE PITTING MECHANISM BY MEANS OF RADIOACTIVE ISOTOPES. Nobuhisa Ujiiye and Keishi Matsumoto. Genshiryoku Kogyo, 9: No. 7, 17-21(July 1963). (In Japanese)

A radioactive tracer technique was used for investigating the mechanism involved in the pitting of metal by wear. A cylindrical steel specimen was activated in the neutron flux of a reactor, after which it was exposed to conditions causing continuous wear in the Nishihara-type wear-testing machine. The rate of wear was determined by collecting the metallic particles removed from the specimen and collected in the lubricating oil, determining the activity of the material collected in a given time interval. An alternation of fast and slow counting rates was observed in the material thus obtained. This phenomenon is attributed to the formation of minute micro-cracks initiated on a portion of the already abraded surface; these cracks first grow slowly and then suddenly cause a fracture as a result of the shearing stress applied. (TTT)

41372 A METHOD FOR GROWING RARE-EARTH SINGLE CRYSTALS. H. E. Nigh (Ames Lab., Ames, Iowa). J. Appl. Phys., 34: 3323-4(Nov. 1963). (IS-619)

Single crystals of yttrium and the heavy rare-earth elements from Gd to Tm were prepared by the annealing of arc-melted buttons. This method resulted in crystals as large as 2.5 × 2.5 × 0.8 cm. (auth)

41373 BERYLLIUM IN NUCLEAR APPLICATIONS. G. Cabane (CEA, Saclay, France). Rev. Met. (Paris), 60: 691-6(July-Aug. 1963). (In French)

The use of Be for canning U pellets is briefly reviewed. The conditions for operation in the EL-4 (heavy water reactor) are discussed with respect to the mechanical, irradiation, and corrosion behavior of Be. The embrittlement of Be from impurities and its purification by electrolysis, distillation, zone melting, and vacuum melting are described. (J.S.R.)

41374 APPARATUS FOR THE ELECTROLYTIC CLEANING AND COATING OF METAL OBJECTS. (to European Atomic Energy Community (EURATOM)). British Patent 939,672. Oct. 16, 1963. Priority date Jan. 14, 1961, Italy.

An apparatus for use in electrolytic cleaning and coat-

ing of cylindrical metal objects such as uranium fuel elements is described. It consists of a drum electrode, means for supporting the drum with its axis horizontal, at least two support hoops around and coaxial with the drum and spaced to serve as support tacks on which the object to be treated may roll, means for supporting the hoops for rocking or oscillating movement about the electrode axis, and means for effecting such movement. (M.C.G.)

41375 NEUTRON RADIATION SHIELDING MATERIAL. Angel Alberto Blanco (to Imperial Chemical Industries Ltd.). U. S. Patent 3,106,535. Oct. 8, 1963. Priority date Aug. 24, 1959, Great Britain.

A radiation shielding material is described that consists of chips of nylon dispersed in mineral oil, water, silicone fluid, or ethylene glycol, and clad in an Al sheet. (T.F.H.)

41376 PRODUCTION OF ACTINIDE METAL. James B. Knighton (to U. S. Atomic Energy Commission). U. S. Patent 3,109,731. Nov. 5, 1963.

A process of reducing actinide oxide to the metal with magnesium-zinc alloy in a flux of 5 mole % of magnesium fluoride and 95 mole % of magnesium chloride plus lithium, sodium, potassium, calcium, strontium, or barium chloride is presented. The flux contains at least 14 mole % of magnesium cation at 600–900°C in air. The formed magnesium-zinc-actinide alloy is separated from the magnesium-oxide-containing flux. (AEC)

41377 OXIDATION-RESISTANT COATING ON ARTICLES OF YTTRIUM METAL. David R. Wilder and Cecil Denton Wirkus (to U. S. Atomic Energy Commission). U. S. Patent 3,109,752. Nov. 5, 1963.

A process for protecting yttrium metal from oxidation by applying thereto and firing thereon a liquid suspension of a fritted ground silicate or phosphate glass plus from 5 to 35% by weight of CeO_2 is presented. (AEC)

Corrosion

41378 (NP-13227) CORROSION PRODUCT SEPARATION IN A CROLOY 9M MERCURY LOOP. Quarterly Report, April 24, 1963 through July 31, 1963. D. B. Cooper and E. J. Vargo (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Aug. 20, 1963. Contract NAS 3-2538. 28p.

Design was completed for a forced-circulation mercury loop to study the feasibility of separating the Croloy 9M corrosion products by hot trapping and magnetic means, and to evaluate the corrosion resistance of Croloy 9M. The design is described, and the status of the procurement and fabrication activities is reported. (D.L.C.)

41379 LONG TERM AIR CORROSION OF SEVERAL NICKEL-BASED ALLOYS. G. W. Titus and J. S. Brunhouse (Aerojet-General Nucleonics, San Ramon, Calif.). Corrosion, 19: 339t-44(Oct. 1963).

In order to provide corrosion data on prospective fuel pin cladding alloys for the ML-1 nuclear reactor, four nickel-based alloys: Inconel 600, Inconel 702, Hastelloy X, and Nichrome V were tested in air at 300 psi and 1750°F for durations up to 10000 hours. Weight changes were determined after various exposure periods. Selected samples were then tensile tested at room temperature to determine changes in strength and ductility. All samples were metallographically examined for depth of penetration, nature of oxide scale and change in internal microstructure. Surface oxidation resistance was evaluated on the basis of length of exposure after which there was no longer a weight gain. Maximum depth of corrosion penetration was another important criterion on which selection of the most suitable alloy was based. Hastelloy X was found most suitable of the four alloys tested and is now in use as the fuel pin cladding alloy. (auth)

41380 STRESS-CORROSION CRACKING OF TYPE 347 STAINLESS STEEL AND OTHER ALLOYS IN HIGH TEMPERATURE WATER. P. D. Neumann and J. C. Griess (Oak Ridge National Lab., Tenn.). Corrosion, 19: 345t-53 (Oct. 1963).

An extensive study was conducted on the susceptibility of Type 347 stainless steel to stress-corrosion cracking in high temperature water over wide ranges of chloride concentration, temperature, oxygen concentration, and pH. No cracking was observed at a chloride concentration of 5 ppm, but cracks were observed at 10 ppm and higher at temperatures of 100°C and above. Maximum susceptibility was found between 150 and 250°C, but no cracking was found below 100°C. No pH effect was noted. Various heat treatments and surface preparations showed no appreciable effect. Nickel plating, even with only partial covering of the surface, was found to inhibit stress-corrosion cracking completely, while chromate and phosphate in solution were effective only at high concentrations. Five other austenitic stainless steels were similar in behavior to Type 347 stainless steel, and three ferritic stainless steels exhibited only slightly better resistance to cracking. Of five high nickel, high chromium alloys tested, only Inconel exhibited complete immunity to stress-corrosion cracking. Cast chromium-nickel stainless steels were found to be extremely resistant to stress-corrosion cracking as long as they were not subjected to cold-working or plastic deformation. Once stressed above the yield, the resistance to cracking could not be regained by annealing. A number of the alloys tested in high temperature water were also tested in boiling 42% $MgCl_2$. It was found that the susceptibility of an alloy to stress-corrosion cracking in boiling 42% $MgCl_2$ solution is not necessarily a measure of its susceptibility in high temperature water containing relatively small concentrations of chloride ion. (auth)

41381 INFRARED SPECTRA STUDY ON THE OXIDATION FILM OF ZIRCONIUM. Tatsuo Maekawa and Minoru Terada (Mitsubishi Atomic Power Industries, Inc., Saitama, Japan). Trans. Japan Inst. Metals, 4: 57-9(Jan 1963).

An investigation was made of the infrared absorption spectra of various zirconium oxides. The spectra of hydrated ZrO_2 had four absorption bands at 2.9, 6.5, 7.5, and 20μ. An amorphous ZrO_2 had an absorption band at 20μ. The tetragonal ZrO_2 had three absorption bands at 17.5, 20, and 27μ. The monoclinic ZrO_2 had five absorption bands at 13.5, 17.5, 19.5, 24.5, and 28μ. The absorption spectra of oxide films on several grades of zirconium and zirconium alloys had five absorption bands similar to the reference monoclinic ZrO_2. Although a consistent relation was not found between the oxidation rate and the infrared absorption frequency, an appreciable difference of infrared absorption frequency was found between the oxide films, which have no difference in the lattice constant by x-ray analysis. (M.C.G.)

Fabrication

41382 (AD-419008) FABRICATION OF ULTRAFINE BERYLLIUM WIRE. Final Report. Technical Report 318-240. E. A. Murphy and R. G. O'Rourke (Brush Beryllium

Co., Cleveland). Aug. 1, 1963. Contract NOw-63-0137-c. 48p.

The results of six month's work directed toward development of a process for the production of ultrafine beryllium wire by warm drawing techniques are described. Clad drawing was found to be unacceptable. Using conventional drawing techniques, long lengths, 200 feet and over of 0.0018 inch-diameter, shorter lengths, 50 to 25 feet of 0.0015-inch diameter, and very short lengths, under 2 feet of 0.00115-inch diameter beryllium wire were produced. The mechanical properties of drawn beryllium wire between the sizes of 0.010- and 0.001497-inch diameter are described. (auth)

41383 (DMIC-Memo-172) PRODUCTION PROBLEMS ASSOCIATED WITH COATING REFRACTORY-METAL HARDWARE FOR AEROSPACE VEHICLES. W. A. Gibeaut and E. S. Bartlett (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 26, 1963. Contract AF33(616)-7747. 23p. (AD-418976)

Four coating processes have been scaled up to coat components of aerospace vehicles: (1) slurry, (2) atmospheric-pressure pack cementation, (3) vacuum pack cementation, and (4) fluidized bed. The principal advantage of the slurry process is its ability to coat limited-access areas such as the interior channels of built-up corrugated panels. This makes the process ideal for coating spot-welded corrugated panels after they have been welded. The other three coating processes, which are vapor-deposition processes, are not so suitable for coating limited-access areas. When they are used for parts such as built-up corrugated panels, the individual parts (including rivets) are coated, then riveted together, and then the entire assembly is recoated. This shortcoming is offset by the fact that the coatings applied by the vapor-deposition processes are more protective at higher temperatures than are the slurry coatings. Designers must be cognizant of the attributes and limitations of various coating systems, so that a minimum number of problems will arise when coating vehicle components and so that the coated hardware will provide reliable performance. Quality control of coating processes is essential to assure reliable performance of coated hardware. Most quality-control programs include close control of coating-process variables, visual inspection, oxidation check tests of specimens coated along with the hardware, and sometimes oxidation proof tests of the actual hardware. Frequently, coating defects can be repaired by re-coating the defect or the entire component, but in some instances, defective parts must be scrapped. Another problem is reactions between coatings and other materials in intimate contact with them (e.g., other coatings, metal, graphite, insulation) at high temperature during service. This can be investigated by placing the coating in contact with the material in question under the anticipated service conditions (temperature and possibly air pressure). (auth)

41384 (HW-79182) A PORTABLE, REMOTE CONTROLLED, AUTOMATIC TUBE WELDER. C. D. Brons (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 8, 1963. Contract AT(45-1)-1350. 19p.

A welding tool was developed to weld thin-wall stainless steel and Inconel tubing under difficult field welding conditions on a large volume basis. These welds consist of fillet or "socket" welds to join couplings to the tubes. The tool is described in some detail, and photographs and blueprints of the tool are included. (D.L.C.)

41385 (HW-SA-3189) PNEUMATIC IMPACTION OF FUEL MATERIALS. K. R. Sump and D. W. Brite (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 9, 1963. Contract AT(45-1)-1350. 8p. (CONF-265-1)

From General Electric Company High Energy Rate Forming Seminar, Schenectady, N. Y., Sept. 1963.

A discussion is presented of the use of Dynapak machines in densifying and forming ceramic and cermet fuel materials, particularly UO_2 and PuO_2-UO_2. In the case of ceramic materials, the impacted material is crushed into ultra-high-density particles for mechanically packed fuel elements, while the cermets may be machined after impaction. A technique for the simultaneous impaction and encapsulation of cermets is described. The impact pressure is limited by the strength of the punches and dies. The advantages of the impaction method are outlined. (D.L.C.)

41386 (NMI-1260) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. DEVELOPMENT OF A FABRICATION PROCESS FOR SEAMLESS TUNGSTEN TUBING. Summary Technical Report to the United States Atomic Energy Commission for the Period July 1, 1962–June 30, 1963. J. G. Hunt, R. G. Jenkins, P. Loewenstein, and A. M. White (Nuclear Metals, Inc., West Concord, Mass.). Oct. 17, 1963. Contract AT(30-1)-2784. 130p.

A method of fabrication is being developed for high-quality wrought seamless tungsten tubing in size ranges from 1.2 to 0.1 in.-OD. The process consists of extrusion of sintered powder tungsten sleeves at elevated temperatures, followed by a finishing operation by warm drawing to achieve satisfactory dimensional tolerances. Tungsten tubing in sizes between approximately 0.75 and 0.25 in. OD was extruded by the "filled billet" method. In this technique, the tungsten sleeve, which occupies a relatively small proportion of the total billet cross section, is surrounded on both outside and inside by other materials called "fillers." After the tungsten and the filler materials are extruded together to form a solid round rod, the filler materials are removed either by acid pickling or by mechanical methods. The removal of the filler material on the inside of the tubing is greatly facilitated by the use of a graphite central core, which is extruded with the billet assembly and is removed by drilling before pickling of the filler material. Two distinct extrusion methods were normally used: at an extrusion temperature of 1800°C (3272°F) the billet filler material was molybdenum; at 1200°C (2192°F), the filler was molybdenum in combination with low carbon steel. Tubing with superior dimensional control and surface finish was obtained at the lower extrusion temperature. The tungsten tubing in the as-extruded condition was evaluated in a limited manner. The tubing, which was shown to be fully dense and free of cracks, had considerable ductility at temperatures near 400°C (750°F). Brittle-to-ductile transition temperatures as low as 40°C (100°F) were obtained. A technique of warm drawing the extruded tungsten tubing to obtain very good surface finishes and dimensions was developed. (auth)

41387 (NP-13167) PLASMA JET WELDING, COATING, AND CUTTING: AN ANNOTATED BIBLIOGRAPHY. Scott J. Buginas, comp. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Feb. 1963. 24p. (SB-63-21)

The search was made in the literature of 1960 to 1962. News-release type articles were included because of interest in manufacturing applications. Anonymous articles are interfiled alphabetically by title within the bibliography which is arranged alphabetically by author. A total of 68 references is given, and a subject index is included. (auth)

41388 (WADD-TR-61-72(Vol.XV)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XV. ALUMINA-CONDENSED FURFURYL ALCOHOL RESINS. C. W. Boquist, E. R. Nielsen, H. J. O'Neil, and R. E. Putcher (Illinois Inst. of Tech., Chicago. IIT Research Inst.). July 1963. Contract AF-33(616)-6915. 61p.

Because alumina-condensed furfuryl alcohol resins offer several advantages over analogous acid-condensed resins, the work described has been directed toward gaining a more complete understanding of their physical and chemical properties, both prior to and during thermosetting and pyrolysis. The work also includes a study of the interactions of the resin when used as a binder with certain filler materials. Equipment and methods used in preparing resins of different viscosities are briefly discussed as is the equipment used in making the necessary analyses. In the discussion of results, data obtained from fractional distillation, gas chromatography, differential thermal analysis, thermogravimetric analysis, x-ray studies, shrinkage measurements, and dynamic elastic modulus measurements are presented, interpreted, and correlated. Also included is information on the use of low viscosity resin as an impregnant, resin modifications, cured resin yield, and microstructures. (auth)

41389 (EURAEC-763) ELECTRO-SLAG WELDING OF REACTOR STEELS. Quarterly Report No. 9, April 1, 1963–June 30, 1963. (Schweisstechnische Lehr- und Versuchsanstalt, Duisburg, Germany). July 22, 1963. Work Performed under Untted States–Euratom Joint Research and Development Program. Contract 046-61-3-RDA. 54p. (A translation)

Reactor steel welds processed by electroslag techniques are evaluated. Results are presented of tensile tests, weld wire properties, temperature distributions and trends in weld area, microstructure, notch bend tests, and DVM and Charpy-V-notch tests. Information is also presented on weld fluxes, types of current, wire electrode polarities, steel compositions, and metallography. (N.W.R.)

41390 (EURAEC-768) RESEARCH ON ELEMENTARY CRACKING. PRELIMINARY TESTS ON THE SUITABILITY OF THE WELDING PROCESS. Quarterly Report No. 2, April 1–June 30, 1963. (Institut de Soudure, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 090-62-12-RDF. 7p. (A translation)

The preparation of Mn–Mo steel sheet specimens is described. The deposition of arc welding beads on the sheet specimens using coated electrodes is reported; the beads are parallel and perpendicular to the skin of the sheet. Conditions (joules/cm) for the implementation of the arc welding beads are tabulated. (D.L.C.)

41391 (EURAEC-771) METHODS EMPLOYED IN THE FABRICATION OF PRESSURE VESSELS. Quarterly Report No. 6, April 1–June 30, 1963. (Neratoom, N. V., The Hague). July 16, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 069-61-12-RD N. 39p. (A translation)

A start was made with the fourth weld, and an analysis of the welding wire was made. Submerged arc welding with a double welding head encountered no difficulties during the welding of the second seam. The results of the nondestructive examination are described. The results of the first weld seam operation performed by carbon dioxide shielding are presented. Two weld seams were made by enclosed carbon dioxide welding. The influence of the welding conditions on penetration are discussed. (auth)

41392 DEVELOPMENT ON THE UO_2 FUEL ROD FORMATION BY A NEW TYPE OF EXTRUDER COMBINED AUGER AND PRESS MECHANISM. Kaoru Umeya, Kosho Watanabe, and Yoshiaki Kondo. Nippon Genshiryoku Gakkaishi, 5: 760-7(Sept. 1963). (In Japanese)

As one of the economical processes to fabricate ceramic fuel, extrusion techniques were studied. It was intended that the process should be such that the obtained rods would be as highly dense and accurate in dimension as is usually claimed for fuel pellets. When the conditions of UO_2 powder, binder, lubricant, and water content were properly selected, the kneaded mass had a moderate plasticity, high green density, and high sinterability. The results revealed the fact that neither the auger-type nor press-type extruder was satisfactory for obtaining the uniform rods. To overcome these difficulties a vacuum extruder furnished auger and press mechanisms was designed that had the advantages of both types. The rods extruded by this mechanism were uniform enough in quality and free from distortion. The extruded rods, thus prepared, were sintered to a density higher than 93% Th.D. at 1700°C for 2 hr in hydrogen with the diametral variation within ±2/100 ~ 3/100 mm for the rods of about 10 mm in diameter, and with the chamber values within ±5/100 mm for the rods about 200 mm long. Their chemical and physical properties were similar to those of cold compacted and sintered pellets. (auth)

41393 RECENT PROGRESS IN THE METALLURGY OF BERYLLIUM. R. Syre and J. M. Logerot (Centre de Recherches Metallurgiques de la Compagnie Pechiney, Chambery, France). Rev. Met. (Paris), 60: 684-90(July-Aug. 1963). (In French)

The problems in the production of Be are discussed in relation to the purity The compacting of Be flakes and powders by induction fusion and arc fusion with consumable electrodes is described. Be can be fabricated by drawing, forging, rolling, and extrusion, and the problems encountered in these procedures are briefly indicated. Recent studies on methods to improve the ductility of the metal are summarized. (J.S.R.)

41394 BETTER BRAZED JOINTS. G. I. Friedman (Institutt for Atomenergi, Kjeller, Norway). Tidsskr. Kjemi, Bergvesen Met., 23: 146-50(Sept. 1963).

Brazing is presented as a technique for making high quality joints for use in corrosive environments and at elevated temperatures. The characteristics of an ideal, as well as commercially available brazing alloys based on silver, nickel, palladium, and gold are discussed. The conditions and equipment required for this type of brazing are described, as are the special factors to be considered in designing for brazed joints. (auth)

41395 MANUFACTURING OF SCANDIUM, YTTRIUM AND GADOLINIUM SINGLE CRYSTALS. E. M. Savitskii, V. F. Terekhova, O. P. Naumkin, and I. V. Burov. Tsvetn. Metal., No. 5, 51-3(1963).

The manufacturing of Sc, Y and Gd single crystals (99.3 to 99.5% pure) by electron-beam zone refining and high vacuum distillation of the rare earth metals and crystal growing by high temperature recrystallization vacuum annealing at 1000 to 1400°C is reported. Microhardness, microstructure, crystal structure, plasticity, magnetization, hardness, thermal expansion, and electric resistance of the single crystals were determined. (Rev. Metal Lit., Vol. 20, No. 10)

41396 HEAT TREATMENT OF COLUMBIUM. G. V. Zakharova and L. P. Zhorova. Tsvetn. Metal., No. 5, 53-8(1963). (In Russian)

Deformed Nb sheets, rods, and strips were vacuum annealed in a furnace with graphite and W heaters. The effects of annealing temperature and vacuum pressure on the remaining H_2, N_2, O_2, and carbon content, resilience, hardness, plasticity, strength, and grain size were determined, along with the optimum annealing temperature for Nb parts undergoing various deformation degrees. (TCO)

41397 ACCURACY HELD ON WELDED REACTOR VESSEL. Welding Eng., 48: No. 7, 48-9(July 1963).

Preweld operations, welding, furnace, and local gas jet stress relieving, x-ray, magnetic particle, and dye penetrant examination, machining, boring, flame cutting, manual grinding, sealing, and hydrostatic and He leak testing in the fabrication of a 306 ton A212-B steel pressure vessel for the Experimental Gas Cooled Reactor are reported. (Rev. Metal Lit., Vol. 20, No. 10)

41398 POROUS REFRACTORY BODIES AND METHODS OF MANUFACTURING THE SAME. (to The Carborundum Co.). British Patent 938,861. Oct. 9, 1963. Priority date Oct. 31, 1958, United States.

A method for the fabrication of porous refractory bodies is presented that comprises the steps of mixing finely divided particles of a refractory material, a carbonaceous binder, and a pore-forming material. The mixture is formed into the desired shape and heated to cure the binder to form a resin matrix or to carbonize the binder to form a carbon matrix within the refractory body. (C.E.S.)

41399 IMPROVEMENTS RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Laurence Frederick Gazeley and William Hay Mackie (to English Electric Co.). British Patent 939,721. Oct. 16, 1963. Filed Nov. 18, 1958.

A process for the manufacture of fuel elements in which a fuel rod is enclosed in a tubular can that is closed at each end and has a coefficient of thermal expansion greater than that of the fuel rod. The process includes heating the can and subsequently bringing the can into intimate engagement with the fuel rod by the application of an enveloping pressure. The can is heated while mounted in a clamp arranged to apply end restraint to the can. (M.C.G.)

41400 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR USE IN THE MOULDING OF ARTICLES FROM POWDERED MATERIALS. Horace James Coomber, James Robert Fynn, and James Forbes Strachan (to General Electric Co. Ltd.). British Patent 939,772. Oct. 16, 1963. Filed Apr. 21, 1961.

An apparatus for use in the manufacture of shaped articles from powdered materials by hydrostatic pressing techniques is described. The compacts produced are of complex shapes with shouldered re-entrant parts. A flexible mold is used with a mold support device for rigidly supporting the filled mold while it is immersed in the pressing liquid. (M.C.G.)

41401 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENTS. (to Mitsubishi Atomic Power Industries Inc.). British Patent 939,800. Oct. 16, 1963. Priority date Feb. 11, 1960, Japan.

A method of preparing nuclear fuel elements by drawing or swaging a cladding tube filled with powdered nuclear fuel material is described. The cladding tube is prepared by removing a surface layer from the internal curved surface of the tube so as to leave the internal curved surface of the tube substantially smooth and free from minute structural defects. The tube is then filled with powdered nuclear fuel material and drawn or swaged. (M.C.G.)

41402 METHOD OF BONDING ALUMINUM MEMBERS. (to North American Aviation, Inc.). British Patent 939,871. Oct. 16, 1963. Application date Sept. 2, 1960, United States.

A method of joining aluminum and aluminum alloys is described. A layer of either silver, copper, gold, tin, or zinc, about 10^{-4}-in. thick is applied to one of the joining surfaces. The mating surfaces are brought together and then heated at a temperature to form a eutectic between the bonding metal and the aluminum for a period of time sufficient to diffuse the eutectic into the aluminum. By this method a bond is formed whose strength approaches that of the parent material and does not diminish at higher temperatures. The temperature at which bond formation takes place depends on the eutectic bonding agent used. (M.C.G.)

41403 METHOD OF AND MACHINE FOR FORMING TUBES WITH LONGITUDINALLY EXTENDING FINS. Allan Keppie Smith (to Babcock and Wilcox Ltd.). British Patent 939,874. Oct. 16, 1963. Filed Sept. 20, 1961.

A method of forming a tube with longitudinally extending fins by welding two metal strips to the tube with the strips diametrically opposed and the edges parallel to the tube axis is described. An apparatus for use in this method was constructed. (M.C.G.)

41404 IMPROVED METHOD AND APPARATUS FOR THE WELDING TOGETHER OF ALIGNED TUBES OR PIPES. (To Philips Electrical Industries Ltd.). British Patent 940,202. Oct. 23, 1963. Priority date Mar. 20, 1959, Netherlands.

A method of welding together aligned tubes or pipes is described, in which the end of at least one contact electrode is disposed so that it engages the adjacent ends of the pipes and, while an electric arc is struck, the electrode is moved about in order to produce one circumferential bead. In welding together upright tubes or pipes, a second circumferential bead is produced above the first circumferential bead so that the joint can be filled satisfactorily. This method can be used for welding under water. (M.C.G.)

41405 A METHOD OF PRODUCING COMPLETELY ENCASED BODIES ON AN EXTRUSION PRESS. (to Metallgesellschaft AG). French Patent 1,253,058. Dec. 26, 1960. Priority date Apr. 4, 1959, Germany.

A method is described for the production of a fuel element by extruding a billet comprising a core of UO_2 and Al powder that is partly enclosed by a casing consisting of a powdered Al alloy containing 1% Ni and for the rest by a cover member consisting of Al powder containing Al_2O_3. (NPO)

41406 METHOD OF MANUFACTURING NUCLEAR FUEL ELEMENTS. (to Mitsubishi Atomic Power Industries, Inc.). French Patent 1,270,380. July 17, 1961. Priority date Oct. 15, 1959, Japan.

To manufacture a tubular fuel element the annular space between two coaxial tubes, such as stainless steel with less than 0.02 wt.% C, is filled with a ceramic fuel, such as UO_2. The annular space is closed at both ends, a mandrel having a modulus of elasticity of 5.10^3–5 kg/mm^2 is inserted in the axial cavity, and the unit is rotary swaged until the required reduction and fuel density are obtained. Finally the mandrel, preferably consisting of a Zn alloy that contains 3–6% Al, less than 5% Cu, and 0.03–1% Mg, is removed by fusion or dissolution. (NPO)

41407 FUEL ELEMENTS FOR NUCLEAR REACTORS AND METHOD OF PREPARATION. (to Deutsche Gold- und Silberscheideanstalt Vermals Roessler). French Patent 1,278,598. Oct. 30, 1961. Priority date Feb. 20, 1960, Germany.

The method concerns high temperature fuel spheres consisting of a shell of nuclear graphite and a core of a mixture of graphite and fissile or fertile material in the atomic ratio 50 : 1. Preferably the core is prepared by heat treatment of a UO_2-graphite compact in vacuum at over 1700°C. Natural graphite can also be applied. (NPO)

41408 METHOD OF MANUFACTURING FUEL ELEMENTS FOR NUCLEAR REACTORS AND FUEL ELEMENTS THUS OBTAINED. (to Deutsche Gold- und Silber-Scheideanstalt vormals Roessler). French Patent 1,278,599. Oct. 30, 1960. Priority date Feb. 24, 1960, Germany.

Fuel spheres are manufactured by compacting a pulverized mass, consisting of graphite powder, carbon black, and a phenolic binder, around a fuel core and heating the molded compact above 1000°C. (NPO)

41409 NUCLEAR FUEL ELEMENTS AND THEIR MANUFACTURE. (to Mitsubishi Atomic Power Industries, Inc.). French Patent 1,279,174. Nov. 6, 1961. Priority date Feb. 12, 1960, Japan.

Fuel rods are manufactured by cold swaging a powder-filled, closed tube in successive passes, the reduction in diameter in each pass not exceeding 8% and the number of passes being such that the thickness of the tube-wall is not materially reduced. Thereafter the tube is hot swaged in a single pass at 1100°C. With UO_2 in stainless steel a density of 94% can be obtained without the appearance of structural faults in the canning. (NPO)

41410 IMPROVEMENTS IN METHODS FOR THE AGGLOMERATION OF METAL POWDERS, NOTABLY OF URANIUM. (to Commissariat a l'Energie Atomique). French Patent 1,282,645. Dec. 18, 1961. Filed Dec. 13, 1960.

A method for the powder-metallurgical manufacture of nonporous and degasified uranium compacts is reported. The U powder is introduced into a tubular rubber container that is provided with an interior retractable Mg liner, the introduction being effected in vacuum or in a neutral atmosphere. A uranium electrode head is inserted into the powder and the container closed at both ends whereupon a hydraulic pressure of 1000–5000 kg/cm^2 is applied to agglomerate the powder. After removal of the rubber container the electrode head is connected with a source of current and the agglomerated powder is sintered and degasified in vacuum at a temperature of 900–1000°C, the Mg liner at the same time being removed by evaporation. The sintering may be followed by fusion, the sintered compact then being used as a consumable electrode. (NPO)

41411 MOULDED PRODUCT FOR NUCLEAR REACTORS, CONSISTING OF PLUTONIUM AND IRON. (to U. S. Atomic Energy Commission). French Patent 1,284,928. Jan. 8, 1962. Priority date Mar. 31, 1960, United States.

Fissure-free Pu fuel slugs were prepared by incorporating 500–1500 ppm Fe into the Pu prior to casting. The elimination of fissures results in an increased resistance to creep, fatigue, and shock. (NPO)

41412 METHOD OF JOINING GRAPHITE ELEMENTS. (to Japan Atomic Energy Research Inst.). French Patent 1,287,618. Feb. 5, 1962. Priority date Feb. 27, 1960, Japan.

Graphite moderator blocks are joined by means of induction or arc brazing at 1200–1600°C in a non-oxidizing atmosphere with an iron alloy containing 16–30% Cr, 6–25% Ni, 0–4% Mo, W, Ti, or Zr and less than 0.2% C. (NPO)

41413 METHOD AND APPARATUS FOR THE MANUFACTURE OF DENSE MASSES FROM REFRACTORY MATERIALS. (to General Dynamics Corp.). French Patent 1,288,272. Feb. 12, 1962. Priority date Feb. 29, 1960, United States.

High density refractory compacts, in particular graphite compacts for nuclear reactors, are manufactured by bilateral compaction of the pulverized material in a cooled, double walled mold at a pressure over 350 kg/cm^2 while the material is electrically heated at a temperature over 2000°C. Two types of apparatus are depicted. (NPO)

41414 NUCLEAR FUEL PELLETS WITH SPECIAL PROFILES AND THEIR METHOD OF MANUFACTURE. (to Commissariat a l'Energie Atomique). French Patent 1,299,652. June 18, 1962. Filed June 12, 1961.

The manufacture of fuel elements by piling up a number of ceramic fuel pellets in a tubular jacket, followed by hydrostatically pressing the jacket against the core is described. In order to prevent irregularities due to mutual shifting of the pellets during the pressing operation it is proposed to apply cylindrical pellets, the end surfaces of which are shaped as male and female truncated cones, adjacent pellets thus fitting snugly into each other. Various shapes and dimensions of these pellets are given. They are manufactured by the method of compressing and sintering. (NPO)

41415 NEW REFRACTORY PRODUCTS, NOTABLY FOR NUCLEAR FUELS, AND THEIR METHOD OF MANUFACTURE. (to Commissariat a l'Energie Atomique). French Patent 1,302,484. July 23, 1962. Filed June 21, 1961.

Eutectic compounds having the composition XO_2/XN or XO_2/YN, X and Y being an actinide or lanthanide metal, are prepared by arc melting a mixture of XO_2 and X or Y, or a mixture of XO_2 and C in a nitrogen atmosphere. Some of the compounds, such as UO_2/UN, ThO_2/UN, ThO_2/ThN, form nuclear fuels that are stated to have advantages over the conventional ceramic fuels. (NPO)

41416 IMPROVEMENTS IN NUCLEAR FUELS. (to General Dynamics Corp.). French Patent 1,305,651. Aug. 27, 1962. Priority date Sept. 30, 1960, United States.

The manufacture of dense ceramic fuel pellets consisting of a ceramic fuel, such as UO_2, and a protective refractory material, such as Al_2O_3 or BeO, is described. Three types are described: dispersion of the fuel in a refractory matrix; compacts of coated fuel particles; and compacts consisting of a fuel core and a refractory casing. (NPO)

41417 METHOD FOR PRODUCING HIGH PURITY GRAPHITE. Charles Vernon Mitchell (to Union Carbide Corp.). German Patent 1,151,248. July 11, 1963. Priority date Aug. 8, 1960, United States.

A method is described for the production of reactor-grade graphite from purified aromatic hydrocarbons. The method comprises the steps of coking acenaphthylene, decacyclene or tetracene, calcining the coke obtained, and finally of graphitizing. A detailed description of the method is given. (Gmelin Inst.)

41418 DUCTILE URANIUM FUEL FOR NUCLEAR REACTORS AND METHOD OF MAKING. Sylvester Thomas Zegler (to U. S. Atomic Energy Commission). U. S. Patent 3,109,730. Nov. 5, 1963.

The fabrication process for a ductile nuclear fuel alloy consisting of uranium, fissium, and from 0.25 to 1.0 wt % of silicon or aluminum or from 0.25 to 2 wt % of titanium or yttrium is presented. (AEC)

41419 SINTERING METHOD. J. M. Googin (to U. S. Atomic Energy Commission). U. S. Patent 3,109,735. Nov. 5, 1963.

Methods of making articles by powder metallurgy techniques are presented. An article is made by packing a metal powder into a desired shape, raising the temperature of the powder compact to a sintering temperature in the presence of a reducing gas, and alternately increasing and decreasing the pressure of the gas while the temperature is being raised. The product has a greater density than can be achieved by sintering for the same length of time at a constant gas pressure. (AEC)

Properties and Structure

Refer also to abstracts 40719, 40777, and 42351.

41420 (AD-292905) MAGNETIC AND STRUCTURE PROPERTIES OF SOLIDS AND SOLUTIONS. Final Report. F. Keffer, J. H. Anderson, and T. Holstein (Pittsburgh. Univ.). [1962]. Contract AF49(638)-323. 14p.

A research program was conducted to study the relationship between the electron and magnetic properties of solids and their crystal structures. Both experimental and theoretical work was carried out. The results, reported in publications, are summarized. (D.L.C.)

41421 (ASD-TDR-63-424) SURFACE INVESTIGATIONS ON PERMANENT MAGNETS. K. J. Kronenberg and R. E. Quear (Indiana General Corp. Magnet Div., Valparaiso, Ind.). May 1963. Contract AF33(657)-8499. 22p. (AD-420234)

The sample preparation techniques that followed (polishing, colloid production and transfer, replication with cast and evaporated films) are described; and the results obtained with Mn alloys, ceramic powders and compacts, and submicron Co–Fe particles and compacts are presented. (D.C.W.)

41422 (CEA-2300) ETUDE D'ALLIAGES U–Pu–Nb A 20 POUR CENT EN POIDS DE PLUTONIUM. (Study of Uranium–20 Wt Per Cent Plutonium–Niobium Alloys). J. Abgrall, P. Barthelemy, and R. Boucher (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Fontenay-aux-Roses). 1963. 36p.

U–Pu–Nb alloys containing 20 wt % Pu and 10, 20, 30, 40, 50, or 60 wt % Nb were studied, principally to determine the feasibility of their use as fuel elements. The fabrication, casting, and homogenization presented certain difficulties due especially to niobium. The transformation temperatures, thermal expansion coefficients, and nature of phases were determined by thermal analysis, dilatometry, micrography, and x-ray diffraction. For similar compositions, U–Pu–Mo and U–Pu–Nb alloys have many common points concerning the presence of zeta phase (up to 40 wt % Nb), the coefficients of expansion, the good behavior during thermal cyclings, and the good resistance to air oxidation in spite of zeta phase. In consequence, irradiation tests in EL-3 reactor (SACLAY) will be carried out in the near future. (auth)

41423 (CEA-2314) METALLOGRAPHIE: L'ATTAQUE THERMIQUE. (Metallography: Thermal Etching). N. Housseau and D. Calais (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). 1963. 20p.

Thermal etching is obtained by annealing the samples in a controlled atmosphere. Nine samples describe this method: application to the metallographic study of uranium, of plutonium ceramics and alloys, and of diffusion couples (plutonium alloys and pure metals). (auth)

41424 (DPST-63-74-8) HYDRIDE ORIENTATIONS AND MECHANICAL PROPERTIES OF THIN-WALLED ZIRCALOY TUBING. USAEC-AECL Cooperative Program Quarterly Progress Report No. 1, August 1963. R. P. Marshall (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1963. Contract AT(07-2)-1. 10p.

Stress orientation tests on six types of Zircaloy tubing were run at applied stresses of 0, 12,000, and 24,000 psi. The susceptibility to stress orientation of the hydride platelets varied widely among the different tubing types and was not defined uniquely by the Zircaloy texture. Some of the fabrication processes appeared to produce constant stress orientation behavior, while other processes produced varying behavior. (D.L.C.)

41425 (HR-63-274) FABRICATION AND PLASTIC BEHAVIOR OF SINGLE CRYSTAL MgO–NiO AND MgO–MnO SOLID SOLUTION ALLOYS. Technical Report No. 21. T. S. Liu, R. J. Stokes, and C. H. Li (Honeywell Research Center, Hopkins, Minn.). Aug. 1963.

A method of producing solid solution MgO–NiO and MgO–MnO single crystals is presented. The compressive yield strength of MgO is shown to increase nearly fourfold when small amounts of either NiO or MnO is in solid solution in MgO. The cleavage and slip behavior of these alloy crystals are found to be identical to that of MgO. (auth)

41426 (HW-SA-2863) HIGH-TEMPERATURE REACTION IN UO_2–TUNGSTEN CERMET. J. L. Daniel (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 10, 1963. Contract AT(45-1)-1350. 5p.

Microscopic observations of UO_2–W cermets at temperatures above 800°C show eruptions in the UO_2 crystals, while the W remains nearly unchanged even with prolonged heating. It is suggested that impurities within the UO_2 may be responsible for the reaction. (D.L.C.)

41427 (IITRI-B231-9) PILOT EVALUATION OF VANADIUM ALLOYS. Interim Report, January 18, 1963–August 17, 1963. F. C. Holtz (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Sept. 20, 1963. Contract NOw-62-0101-c. 35p. (AD-418758)

Two experimental alloys, V–35 wt % Cr–1 wt % and V–25 wt % Mo–2.5 wt % Hf–0.1 wt % C, exhibited severe cracking when fabricated to 0.050 inch sheet; grain boundary precipitates were noted. Property evaluations for wrought material from 100-pound melts of V–60 wt % Nb–1 wt % Ti and V–20 wt % Nb–4 wt % Ti–1 wt % Zr–0.075 wt % C are reported from data obtained at IITRI and at other organizations participating under this data exchange program. Results of bend, tensile, compression, and oxidation tests are tabulated for alloy specimens at room and elevated temperatures; welded sheet samples were included in these evaluations. Results to date indicate that V–60 wt % Nb–1 wt % Ti is superior in strength properties to the high-vanadium alloy on a density-corrected basis. (auth)

41428 (IITRI-B6007-4) DISPERSION-STRENGTHENED VANADIUM ALLOYS. Bimonthly Report No. 4, June 14, 1963–August 13, 1963. F. C. Holtz (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Sept. 9, 1963. Contract N600(19)59567. 15p. (AD-418081)

Dispersion-strengthening mechanisms are being investigated as a means of improving creep and stress-rupture properties of vanadium-columbium-base alloys.

heat-treating studies of arc-melted and wrought materials containing hafnium or zirconium with carbon indicated that compositions based on V–60 wt % Cb are comparatively susceptible to hardening by traces of atmospheric contaminants after prolonged exposure at 2000 and 2300°F. Virtually no room-temperature hardening was observed in V–40 wt % Cb–30 wt % Ta base alloys exposed to the same annealing atmospheres. Carbide and oxide dispersants were produced in a V–60 wt % Cb–1 wt % Ti matrix by powder metallurgy techniques. After sintering the compacted powders for 10 minutes at 2800°F and annealing for 16 hours at 2400°F, compositions containing HfC and ZrC exhibited little hardening of the V–Cb–Ti alloy matrix. Dispersions of yttria, lanthana, and hafnia produced large increases in the room-temperature hardness of the matrix after sintering and annealing. (auth)

41429 (NLCO-892) ELECTRON MICROPROBE EXAMINATION OF URANIUM. J. W. Colby (National Lead Co. of Ohio, Cincinnati). Sept. 16, 1963. Contract AT (30-1)-1156. 26p. (CONF-253-1)

From 13th Annual National Lead Company Analytical and Physical Testing Symposium, Hightstown, N. J., Oct. 1963.

A description is given of some preliminary studies of uranium conducted employing a electron microprobe x-ray analyzer. As the number of microprobe analyzers in use continues to grow, this instrument is gaining acceptance as a unique tool for conducting materials research and development. Areas as small as 1 micron in diameter may be quantitatively analyzed, with an accuracy of 1 per cent, for all elements having atomic numbers greater than that of sodium. Concentrations as small as a few hundred parts per million may be determined. In addition, the microprobe analyzer may be used in a scanning mode to obtain linear traces or two-dimensional x-ray pictures showing the distribution of elements in a matrix. Thus, individual phases, such as solid solutions and precipitates, may be characterized. Segregation effects caused by impurity elements which form depleted or enriched zones in and around grain boundaries may be detected. Concentration gradients across diffusion boundaries of experimental couples may readily be determined. (auth)

41430 (NP-13073) GALLIUM. Bibliography Bulletin, 1963. Pierre de la Breteque (Société Francaise pour l'Industrie de l'Aluminium, Marseille). June 1963. 75p. (In English and French)

The first annual supplement of the bibliographic work on Ga published in June 1962 is presented. It comprises articles that were collected from May 1, 1962, to April 30, 1963. The bibliography is divided into chapters on geochemistry, preparation and purification, physics of the element, physics of solid compounds, chemistry of Ga and its compounds, analysis, biology, and uses. Included are author and patent indexes. (J.S.R.)

41431 (NP-13157) STRENGTHENING OF CHROMIUM–MAGNESIA COMPOSITES. Interim Report No. 3, June 1, 1963 through July 31, 1963. G. C. Reed (Bendix Corp. Bendix Products Aerospace Div., South Bend, Ind.). Aug. 23, 1963. Contract N600(19)58647. 17p.

The initial effort has been directed toward optimizing ductility prior to investigating alloy conditions for strengthening. In the previous reporting period, it was found that reducing the MgO content to 3% from the 6% level used in production chrome-30 material increased the tensile elongation almost twofold. Further studies of variations in MgO content are reported. These investigations have shown 2% MgO to be the optimum ceramic level from the standpoint of strength and ductility. The oxidation resistance of the composites containing various amounts of MgO was evaluated at 2200°F and appeared to be independent of the MgO contents studied. The tensile transition temperature of the extruded material containing 2% MgO was found to be approximately 35°F. The effects of annealing at 2500°F were also briefly investigated. A base composition for the alloy phase of the program was established as a result of these studies and fabrication of alloy extrusions has been initiated. (auth)

41432 (NP-13228) ENGINEERING PROPERTIES OF POTASSIUM. Quarterly Report No. 11, April 1–June 30, 1963. Alexis W. Lemmon, Jr. (Battelle Memorial Inst., Columbus, Ohio). July 30, 1963. Contract NAS-5-584. 18p.

Measurements of the viscosity, vapor pressure, thermal conductivity, and heat content of liquid potassium have been concluded. In addition, vapor compressibility has been measured in the P-V-T apparatus. Also concluded has been the design study of equipment for the direct determination of the specific heat of potassium vapor. The vapor pressure and compressibility data were used to derive a virial equation of state which, in turn, was used for the computation of enthalpy, entropy, and the specific heat of the vapor; the specific heat values of the vapor are currently reported. Experimental effort is currently limited to the final assembly of the apparatus for measuring the thermal conductivity of potassium vapor and its subsequent operation. The thermal conductivity and electrical resistivity of liquid potassium have been measured to about 1150°C and the experimental results are reported. The data are considered to be reliable to about 800°C, and from 87 to 781°C they can be expressed by $k = 0.543 - 0.333 \times 10^{-3}\,t$, where k is the thermal conductivity in watts cm^{-2} cm $°C^{-1}$ and t is temperature in degrees C. Above 800°C, extrapolation by means of the average Wiedemann-Franz-Lorenz constant of 2.14×10^{-8} watt-ohm C^{-1} and the observed electrical resistivity values is recommended. Leakage of potassium within the apparatus probably explains the anomalous behavior of the thermal conductivity data between 800 and 1150°C. Activity on the experimental program directed at the measurement of the viscosity of potassium vapor has been indefinitely suspended. Values for the specific heat of potassium vapor have been computed from known thermodynamic relations and the virial equation of state previously derived in this program from experimental data obtained. A graphical representation is presented. Effort has continued on the design and construction of the dynamic, bare-wire probe apparatus for the measurement of the thermal conductivity of potassium vapor. In addition, estimates of convection effects have shown them to be negligible for short times but radiation effects have been estimated to be extremely significant. Radiation will represent about 75 per cent of the heat transferred from a bare-wire probe 0.001 inch in diameter at 1200°C. Proper and essentially continuous calibration will be necessary to subtract the radiation mode in the measurements. Assembly of the apparatus followed by the experimental measurements is planned. (auth)

41433 (NYO-4690) THERMODYNAMIC STUDIES OF TERNARY LIQUID METALLIC SYSTEMS CONTAINING MISCIBILITY GAPS. I. THE ALUMINUM–BISMUTH–LEAD SYSTEM. T. C. Wilder and J. F. Elliott (Massachusetts Inst. of Tech., Cambridge. Dept of Metallurgy). [Mar. 1, 1963]. Contract AT(30-1)-1888. 58p.

The partial and integral molar thermodynamic properties of the liquid Al–Bi–Pb system were determined by

emf measurements of the reversible concentration cell. Al(liq.) $|Al^{+++}(AlCl_3$ in KCl·NaCl)| Al (in Bi, Pb, or Bi–Pb) (liq.) in the range 700 to 1000°C, and distribution measurements of the two-phase alloys at 900°C. The measured properties of this system were compared with estimates based on several theoretical treatments contained in the literature. The partial and integral molar properties of mixing, i.e. F_i^M, S_i^M, H_i^M, F^M, H^M, and S^M, in this system have higher positive deviations from ideality than the theoretical treatments would indicate. The miscibility gaps at 900°C of the Al–Pb and Al–Bi systems are not as wide as those reported previously in the literature. (auth)

41434 (ORNL-TM-665) MECHANICAL PROPERTIES OF THE UO_2–TYPE 347 STAINLESS STEEL CERMET FOR CORE B OF THE FERMI REACTOR. J. T. Venard and R. W. Swindeman (Oak Ridge National Lab., Tenn.). Oct. 24, 1963. Contract W-7405-eng-26. 22p.

The mechanical properties of the fuel-bearing portion of the Fermi Reactor Core B fuel element were investigated. Data are presented on the variation with temperature of elastic modulus, yield strength, tensile strength, and elongation of the UO_2-type 347 stainless steel cermet. Strain-fatigue data at 1150°C, 120 cycles per hour, are also discussed. Typical microstructures before and after test are illustrated and discussed. (auth)

41435 (UCRL-7172) THE PHASE DIAGRAM OF PLUTONIUM. D. R. Stephens (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 8, 1963. Contract W-7405-eng-48. 14p.

The pressure dependence of the phase transitions of plutonium, including melting, was measured to 35 kilobars. The phase transitions were detected by differential thermal analysis and by volume discontinuity. Three triple points were detected, the γ-δ-ϵ, γ-ϵ-liquid, and β-γ-liquid. The technique was not sufficiently sensitive to detect the δ-δ' transition, and thus the γ-δ-δ' triple point was not determined. (auth)

41436 (UCRL-10846) CONTROLLED MICROSTRUCTURE OF REFRACTORY BODIES. Richard M. Fulrath (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 6, 1963. Contract W-7405-eng-48. 11p. (CONF-135-2)

From International Symposium on High-Temperature Technology, Asilomar, Calif., Sept. 1963.

The development of controlled microstructures in refractory materials is necessary for their use at high temperatures, since fine grains and maximum density are needed for such use. The characterization of microstructures is discussed. The production of polycrystalline single-phase and multiphase bodies is described in some detail. The control of microstructure depends on the processing method and on the response of the material to the method. The use of model microstructures in lower melting compounds is considered. (D.L.C.)

41437 (EURAEC-598) STUDY OF GAMMA GRAIN GROWTH IN TERMS OF THE TIME AND THE TEMPERATURE. Special Report No. 9, July 1–September 30, 1962. (Societe des Forges et Ateliers du Creusot, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 073-61-12-RDF. 73p. (A translation)

Gamma grain growth evolution in austenitic steel is studied in terms of temperature (800 to 1300°C) and time (7 min to 9 hr) for a series of 21 castings containing different amounts of seven refining elements (aluminum, niobium, tantalum, titanium, vanadium, uranium, and zirconium). The refining elements are classified from the data according to grain growth inhibition. Uranium and vanadium have the greatest inhibitory effects, followed by zirconium and tantalum, then titanium, and finally aluminum and niobium. The time-temperature relations are demonstrated. (N.W.R.)

41438 (EURAEC-799) STUDY OF TRANSFORMATION POINT VARIATION. INFLUENCE OF ALLOY ELEMENTS AND IMPURITIES ON THE START OF THE GAMMA–ALPHA TRANSFORMATION. Technical Report No. 18, March 1963–June 30, 1963. (Société Anonyme des Forges et Ateliers du Creusot). Aug. 23, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 073-61-12-RDF. 10p. (A translation)

For the various steel compositions studied it can be observed that: molybdenum and chromium (content 2–4.3%) have no noticeable influence on the point values; nickel has an action perceptibly proportioned to its content shown by a lowering of the transformation point temperature; silicon, manganese, and chromium (1–2%) have a comparable influence with a more modest effect for points "a," 2 and 5% transformation; and impurities have no noticeable influence on transformation points. The magnetic method allows for a better grasp of the start of transformation. For certain intermediary cooling rates, the thermal method gives a classic curve whilst the magnetic method reveals some anomaly between 500 and 600°C. This anomaly disappears at higher cooling speeds. (auth)

41439 A NEUTRON DIFFRACTION INVESTIGATION OF Cr_2Te_3 AND Cr_5Te_8. Arne F. Andresen (Institutt for Atomenergi, Kjeller, Norway). Acta Chem. Scand., 17: 1335-42(1963). (In English)

Neutron diffraction diagrams of Cr_2Te_3 and Cr_5Te_8 were run above and below the Curie points to investigate the magnetic ordering process. In both compounds the magnetic moments were found to order ferromagnetically with their direction along the hexagonal axis. On cooling Cr_2Te_3 shows a contraction of the unit cell along the c-axis, but no atomic displacements. In Cr_5Te_8 no contraction is visible, but the tellurium atoms are slightly displaced in the c-axis direction. The monoclinic splitting in Cr_5Te_8 decreases at low temperatures. The average magnetic moments deduced are 2.70 μ_B for Cr_2Te_3 and 2.10 μ_B for Cr_5Te_8. Possible reasons for the low magnetic moments are discussed. (auth)

41440 COMPLEX OXIDE SYSTEMS OF BARIUM AND PLUTONIUM. D. M. Chackraburtty, N. C. Jayadevan, and C. K. Sivaramakrishnan (Atomic Energy Establishment, Trombay, India). Acta Cryst., 16: 1060-1(Oct. 10, 1963).

Crystallographic studies were made on the Ba-Pu-O system. Barium plutonate(VI) was precipitated from an acid solution of plutonium(VI) and barium ions with ammonium hydroxide or sodium hydroxide solution. The ratio of the Pu atoms to Ba atoms was found to change from 0.6 to 6.7. X-ray examination revealed mainly amorphous patterns in all samples. The samples were heated to 900°C to observe any phase change that might take place. On heating, the precipitates obtained in the presence of ammonium hydroxide developed PuO_2 lines, whereas those obtained in the presence of sodium hydroxide revealed a cubic ABO_3 perovskite structure with cell dimensions $a = 4.322 \pm 0.003$ A. Freshly prepared pure barium oxide was mixed with plutonium dioxide in approximately 1:1 ratio and heated in an argon atmosphere. The preparations obtained at 1100°C gave along with PuO_2 a perovskite

structure with bigger cell dimensions a = 4.373 ± 0.003. At 1600°C the cubic perovskite underwent a phase change to an orthorhombic form with a = 5.795 ± 0.004, b = 5.861 ± 0.004, c = 5.983 ± 0.004 Å and Z = 2. The valency of plutonium in both orthorhombic and cubic forms was found to be IV. (P.C.H.)

41441 SYMPOSIUM ON MAJOR EFFECTS OF MINOR CONSTITUENTS ON THE PROPERTIES OF MATERIALS. From the 2nd Series in Am. Soc. Testing Mater., Spec. Tech. Publ., 304: 1-89(1962). Philadelphia, American Society for Testing and Materials, 1962. $3.75.

Five articles are included: separate abstracts were prepared for two. One article on the problem of gas purity in plasma physics and technology was previously abstracted in NSA. The remaining two articles include information on role of major effects from minor constituents on organic structural polymers and the effects of small amounts of extraneous materials on properties of petroleum, petroleum products, and related liquids. (P.C.H.)

41442 IMPURITY EFFECTS IN HIGH-PURITY METALS. L. L. Wyman and G. A. Moore (National Bureau of Standards, Washington, D. C.). Am. Soc. Testing Mater., Spec. Tech. Publ., 304: 3-16(1962).

The effects of impurities on high-purity metals is evaluated in terms of the rate at which the science of metals is advancing, and what is needed to enhance materials knowledge. The definition of purity, types of effects, and hydrogen embrittlement are discussed, along with examples of impurity effects in Fe, Ag, W, Al, and Cr. (P.C.H.)

41443 THE EFFECT OF IMPURITIES ON THE PROPERTIES OF CERAMIC MATERIALS. Ivan B. Cutler (Univ. of Utah, Salt Lake City). Am. Soc. Testing Mater., Spec. Tech. Publ., 304: 17-41(1962).

The effects of impurities on structural properties, such as diffusion, sintering, grain growth, and crystal growth, and mechanical properties, such as plastic deformation, creep, brittle fracture and internal friction, and electrical and optical properties of ceramic materials are discussed. It was concluded that ceramic materials differ markedly from metals in that impurities promote the formation of vacancies that are stable at low temperatures, and impurities form donor and acceptor levels in the energy gap between the conductions and valence band. (P.C.H.)

41444 THORIUM DIFFUSION IN PYROLYTIC CARBON AND POROUS GRAPHITE. J. Truitt, G. D. Alton, and C. M. Blood (Oak Ridge National Lab., Tenn.). Appl. Phys. Letters, 3: 150-2(Nov. 1, 1963).

Coefficients for diffusion of thorium in graphites and pyrographites are presented for temperatures of 1270 to 2310°C. The specimens were bombarded with singly charged Th^{232} ions at 40 kev and then annealed. The specimens were then exposed to thermal neutrons to form Th^{233} which decayed to Pa^{233} and the following gamma activity was used to analyze the retainment of Pa^{233} and, therefore the retainment of Th^{232}. (R.E.U.)

41445 BUCKLING OF BERYLLIUM PLATES AND CYLINDERS. A. Bruce Burns and Robert F. Crawford. Astronaut. Aerospace Eng., 1: 36-41(Oct. 1963).

Data from experiments with cross-rolled sheet to demonstrate beryllium's buckling and post-buckling characteristics at room temperature and 800°F show that, although certain structural responses peculiar to beryllium do occur during buckling, conventional methods can be used for predicting buckling strength and stress. In general, the calculated buckling curves gave slightly conservative predictions. (M.C.G.)

41446 SEMICONDUCTOR RADIATION DETECTORS. W. K. Hofker. Atoomenergie Haar Toepassingen, 5: 153-61(Aug. 1963). (In Dutch)

The properties of p-n and p-i-n semiconductor detectors are reviewed by treating various uses. Semiconductor detectors have found an especially wide application in nuclear physics studies. This is because the energy of two alpha particles, protons, or deuterons can be measured with very good resolution. The response time of these counters is very short as a rule, which is of importance for coincidence measurements. The requirements placed on the associated electronics were described. Special attention must be given to the reduction of the noise and increase of the stability of the amplifier. (tr-auth)

41447 ON THE ANOMALOUS SELF DIFFUSION IN BODY-CENTERED CUBIC ZIRCONIUM. G. V. Kidson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 41: 1563-70(Oct. 1963). (AECL-1817)

Results of recent diffusion studies in the BCC phase of Zr give unusually low values of the parameters Q and D_0 in the expression for the diffusion coefficient $D = D_0 \exp(-Q/RT)$. Measurements in the high-temperature range show a marked departure from linearity in a plot of log D vs. 1/T. A simple model is proposed to account for these results based on the assumption that excess vacancies introduced by impurities (probably oxygen) predominate in the low-temperature region. It is found that for zirconium the measured diffusion coefficient can be represented over the whole temperature range by $D = 1.34 \exp(-65{,}200/RT) + 8.5 \times 10^{-5} \exp(-27{,}000/RT)$ cm^2/sec. The calculated concentration of excess vacancies is 0.038 atomic per cent. (auth)

41448 THE NATURAL EPITAXY OF URANIUM DIOXIDE AND FLUORINE. Parviz Assadi and Colette de Rango (Faculté des Sciences, Paris and CNRS, Bellevue, France). Compt. Rend., 257: 1066-9(July 29, 1963). (In French)

An epitaxic arrangement of uranium dioxide and fluorine was shown by radioautography and electron microscope. A theoretical interpretation was given. (tr-auth)

41449 TOTAL CROSS SECTION OF PHOSPHORUS FOR NEUTRONS AT 800 TO 1200 kev. Jean Cabe, Michel Lauret, and Pierre Yvon. Compt. Rend., 257: 1073-4 (July 29, 1963). (In French)

The successive utilization of the time-of-flight technique to measure with precision some mean cross sections (ΔE = 10 kev) and a direct beam without modulation to obtain a very high resolution in energy (ΔE = 4 kev) and a good yield, with a 2-Mev Van de Graaff, permitted the measurement of the total cross section of P for neutrons at 830 to 1200 kev with a mean error of 3%. The variation curve has numerous sharply separated levels. (tr-auth)

41450 THE HEATING AND FUSION WITHOUT CRUCIBLE BY HIGH-FREQUENCY INDUCTION OF STABILIZED ZIRCONIA. Monique Perez y Jorba and Robert Collongues. Compt. Rend., 257: 1091-3(July 29, 1963). (In French)

Experiments made on the high-frequency induction heating of stabilized ZrO_2 fritted cylinders 25 mm in diameter are reported. The samples are composed of a ZrO_2–CaO solid solution containing 10% CaO. By the utilization of a frequency of 20 Mc, the penetration depth is of the order of 1 to 3 cm for a sample preheated at 1200 to 1600°C. The external layers of the sample remain solid. CeO_2 and TiO_2 could be fused under the same conditions. A stabilized zirconia heating element was constructed that can

maintain temperatures near 1900°C for prolonged heat treatments. (J.S.R.)

41451 CONTRIBUTION TO THE STUDY OF THE REACTION OF HYDROGEN WITH LIQUID SODIUM. Gérard Naud, Jacques Sannier, and Pierre Vallet (Centre d'Études Nucléaires, Saclay, France and Faculté des Sciences, Rennes, France). Compt. Rend., 257: 1276-9(Aug. 5, 1963). (In French)

The reaction of H_2 with Na is studied at 150 to 250°C, at pressures around 150 mm Hg. From the variation of the reaction rate with temperature, the activation energy for the process is set at 16.5 kcal/mole. (tr-auth)

41452 DIFFUSION OF PLUTONIUM AND URANIUM IN MAGNESIUM. Daniel Calais, Michel Beyeler, Michel Mouchnino, Annick Van Craeynest, and Yves Adda (Centre d'Études Nucléaires, Fontenay-aux-Roses, France and Centre d'Études Nucléaires, Saclay, France). Compt. Rend., 257: 1285-7(Aug. 5, 1963). (In French)

Experimental data are presented concerning the solubility and diffusion of U and Pu in Mg. (tr-auth)

41453 THE SYSTEM ZIRCONIUM–OXYGEN–POTASSIUM. Michel Tournoux and Jacqueline Leroy (Faculté des Sciences, Bordeaux). Compt. Rend., 257: 1291-3(Aug. 5, 1963). (In French)

The metazirconate of potassium (K_2ZrO_3) is degraded at 600°C to give, successively, $K_2Zr_2O_5$, $K_2Zr_3O_7$, and monoclinic zirconia. The metazirconate crystallizes in the orthorhombic system with four K_2ZrO_3 units per cell. It is found that $K_2Zr_2O_5$ crystallizes in the orthorhombic system, also with four $K_2Zr_2O_5$ units per cell. The x-ray spectra of $K_2Zr_3O_7$ show it to belong to the quadratic system. The cell parameters of these three types of cells are given. (tr-auth)

41454 THE SYSTEM Al_2O_3–Nb_2O_5. G. K. Layden (United Aircraft Corp., East Hartford, Conn.). J. Am. Ceram. Soc., 46: 506(Oct. 1963).

Phase studies were made on the system Al_2O_3–Nb_2O_5, and x-ray diffraction powder data are tabulated. Studies on closely spaced compositions in the Nb_2O_5-rich portion of the system indicate that little or no solid solution of Al_2O_3 in Nb_2O_5 occurs but rather that two distinct phases exist that are clearly separated by two-phase regions. (P.C.H.)

41455 DESTABILIZATION OF ZIRCONIA BY CYCLIC HEATING. John D. Buckley and H. H. Wilson (Clemson Coll., S. C.). J. Am. Ceram. Soc., 46: 510(Oct. 1963).

Calcium-stabilized zirconia refractories used in a heat-exchange furnace were found to lose their mechanical strength after a period of use. Mechanical deterioration was most severe in the positions in which the temperature cycled between 1600 and 2000°F. Since the zirconia used was only partly stabilized and because maximum destabilization occurred in the range in which monoclinic zirconia inverts to tetragonal zirconia, it appears that the cubic zirconia was destabilized by the inversion of monoclinic and tetragonal zirconia. A sample of completely stabilized zirconia (100% cubic) was not affected by 100 cycles in laboratory tests. (P.C.H.)

41456 DIELECTRIC CONSTANT OF LEAD TITANATE ZIRCONATE CERAMICS AT HIGH FREQUENCY. R. Gerson (Clevite Corp., Cleveland), J. M. Peterson, and D. R. Rote. J. Appl. Phys., 34: 3242-5(Nov. 1963).

A region of dielectric dispersion was found in ferroelectric lead titanate zirconate ceramics at frequencies about 1 Gc. The losses associated with the dispersion are quite high, the dissipation factor rising to about 0.4 at 2 Gc. The magnitude of the dispersion is halved in the measured frequency range 500 Mc to 2 Gc by electrical orientation (poling) of the ceramic. Two mechanisms that may account for the effect, inertial clamping of the piezoelectric response of ferroelectric domains and clamping of domain-wall motion, are discussed. (auth)

41457 INTERNAL FRICTION IN BERYLLIUM. Choh-Yi Ang and Kenneth T. Kamber (North American Aviation, Inc., Anaheim, Calif.). J. Appl. Phys., 34: 3405-7(Nov. 1963).

The internal friction in Be wire specimens was measured using a simple, inverted, torsional-pendulum system. Temperatures at liquid nitrogen to 735°C at a frequency of about 1 cps were used. (R.E.U.)

41458 THE DEPENDENCE OF THE LOWER YIELD STRESS ON GRAIN SIZE IN NIOBIUM. P. R. V. Evans (Illinois Inst. of Tech., Chicago). J. Inst. Metals, 92: 57-8 (Oct. 1963).

The strain-anneal technique of producing various grain sizes in Nb was investigated. Two series of specimens were prepared: vacuum-annealed in the range 1400 to 1600°C; and vacuum-annealed at 1400°C, strained varying amounts at room temperature, and re-annealed at 1400°C. The strain-annealing behavior of Nb under these conditions showed a peak grain size at ~6% pre-strain. Room-temperature tensile tests carried out at a crosshead speed of 0.02 in./min gave a strain rate of 4.5×10^{-4}/sec for straight-annealed specimens but somewhat lower rates for the strain-annealed series owing to their initially, slightly longer gauge-lengths. It was concluded that the strain-anneal technique of producing variations in grain size certainly yields a larger and more realistic value for k_y, which is a measure of the contribution made by grain size, than has previously been reported for Nb. (P.C.H.)

41459 FURTHER STUDIES ON THE DECOMPOSITION OF THE γ PHASE IN URANIUM-LOW MOLYBDENUM ALLOYS. R. F. Hills, B. W. Howlett, and B. R. Butcher (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Less-Common Metals, 5: 369-73(Oct. 1963). (AERE-M-1142)

The transformations that occur when uranium–molybdenum alloys in the composition range 0.9–4.17 at. % molybdenum are cooled at various rates from the γ phase field were studied by an end-quenching technique. The resulting structures were examined by metallography, x-ray diffraction, and hardness measurements. The sequence of phases observed at various cooling rates was elucidated and it is shown that there is direct transformation from γ to α or (α + γ) for alloys containing 2.5 at. % or more of molybdenum, and that the γ-grain size has an effect on the decomposition product. (auth)

41460 A SURVEY OF THE BINARY SYSTEMS OF TECHNETIUM WITH GROUP VIII TRANSITION ELEMENTS. J. B. Darby, Jr., L. J. Norton, and J. W. Downey (Argonne National Lab., Ill.). J. Less-Common Metals, 5: 397-402(Oct. 1963). (TID-18353; UAC-7238)

A preliminary survey was made of the phases present in the binary systems of Co- and Ni-group elements with Tc at 1050°C. It was found that these elements have extensive solid solubility in Tc and that intermediate phases are not present at the temperature studied. In most of the systems investigated, the elements of the Co and Ni groups appear to have a higher solubility in Tc than in Re. (auth)

41461 THE EFFECT OF NITRIDING UPON THE CREEP PROPERTIES OF SOME MOLYBDENUM ALLOYS.

A. K. Mukherjee and J. W. Martin (Oxford Univ.). J. Less-Common Metals, 5: 403-10(Oct. 1963).

Creep tests for 100 hr at temperatures between 950 and 1250°C were carried out on strip specimens of Mo–0.49% Ti, Mo–0.98% Ti, and Mo–1.5% Zr in both dispersion-hardened and recrystallized conditions. The nitrided specimens had much longer creep lives and lower creep rates for the same stress and temperature compared with the un-nitrided Mo–Ti specimens, although the Mo–Zr alloy exhibited no steady-state creep. The activation energy and stress dependence of the creep rate were evaluated for the nitrided Mo–0.49% Ti alloy, and a metallographic and fractographic study was made of the tested specimens. The results are discussed in terms of current theories of creep in dispersion-hardened alloys. (auth)

41462 MELTING POINTS OF $LaRu_2$, $CeRu_2$, AND $PrRu_2$. Robert D. Reiswig and Karl A. Gschneider, Jr. (Los Alamos Scientific Lab., N. Mex.). J. Less-Common Metals, 5: 432-3(Oct. 1963).

A technique for determining the melting points of $LaRu_2$, $CeRu_2$, and $PrRu_2$ is described. The observed melting points were: $LaRu_2$ = 1431 ± 30°C; $CeRu_2$ = 1539 ± 30°C; and $PrRu_2$ = 1681 ± 15°C. The reported melting points are the arithmetic means of the equilibrium temperatures observed at two adjacent settings, accounting for the principal experimental error. (P.C.H.)

41463 URANIUM AND BERYLLIUM COMPATIBILITY. Eva Karnikova, Miroslav Holinka, and Vladimir Masarik. Jaderna Energie, 9: 277-80(1963). (In Czech.)

Quantitative investigations were made of uranium and beryllium diffusion. Papers concerning this problem are reviewed, and the experimental method used for material compatibility tests is described. The method and results of quantitative metallographic evaluation and the calculation of activation energy of this process are given. (auth)

41464 SURFACE TENSION OF URANIUM AND PLUTONIUM AT THE MELTING POINT. B. Spriet (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Mem. Sci. Rev. Met., 60: 537-40(July-Aug. 1963). (In French)

The achievement of a floating zone melting apparatus, especially studied for radioactive materials refining, enabled the surface tension of molten uranium and plutonium to be determined by the drop-weight method: 1500 dynes/cm for uranium, 550 dynes/cm for plutonium. (auth)

41465 STUDIES ON THE RECRYSTALLIZATION OF ELECTRON BEAM MELTED NIOBIUM. E. Erben and F. Sperner (W. C. Heraeus GmbH, Hanau, Ger.). Metall, 17: 1019-23(Oct. 1963). (In German)

The recrystallization behavior and the mechanical-technological properties of electron-beam-melted niobium were investigated. The recrystallization was accelerated by increasing the cold working, the annealing temperature, and the annealing time. An actual critical degree of deformation does not exist. From the large-grained electron-beam-melted niobium, the recrystallization limits of a fine-grained material can be obtained by suitable choice. The advantages of electron-beam melting of niobium as compared with sintering are that the requirements for the starting material are not so high as for sintering and it is possible to produce larger blocks for preparation of large half-finished products. (tr-auth)

41466 PHASE CHANGE AND HEAT TREATMENT OF U–Si ALLOYS. Ko Soeno (Hitachi Ltd., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 665-71(Aug. 1963). (In Japanese)

A series of uranium alloys varying in silicon content 0.5–1.0 at. % were studied. The tendency of the β or γ phase uranium to retain upon quenching was examined as a function of silicon content. The β phase can be retained at room temperature, while retention of the γ phase could not be observed. TTT diagrams and microstructures after isothermal transformation were studied, and the existence of two modes in the β-to-α transformation was clarified. The M_s temperature of the martensitic β-to-α transformation, which increases with decreasing silicon content, was determined and it was found that suitable grain-refinement is attained by isothermal transformation in the temperature region slightly higher than the M_s temperature. (auth)

41467 URANIUM SULFIDE AS A NUCLEAR FUEL MATERIAL. Kazuhiko Yoshioka (Atomic Fuel Corp., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 677-83(Aug. 1963). (In Japanese)

The properties of uranium monosulfide were reviewed from a viewpoint of nuclear fuel material. The preparation methods are also described. As a result of recent researches, the sulfide is known to be a promising nuclear fuel material because of its high melting point, uranium density comparable to that of UO_2, semi-metallic properties, chemical stability, and compatibility with some cladding metals. (auth)

41468 ON THE β-TO-α TRANSFORMATION AND GRAIN-REFINEMENT OF U AND ITS DILUTE ALLOYS. Kō Soeno (Hitachi Ltd., Japan). Nippon Genshiryoku Gakkaishi, 5: 754-9(Sept. 1963). (In Japanese)

The kinetic behavior of the β-to-α transformation in uranium binary alloys containing less than 1 at. % of Cr, Fe, Mn, Mo, Si, V, Ti, or Zr were studied. The results lead to the conclusion that nucleation-and-growth and martensitic mechanisms are confirmed in such alloys containing Cr, Fe, Mn, Mo, Si, or V whose β-uranium decomposes to α-uranium in eutectoid reaction. M_s temperatures are summarized in the six alloys. Grain diameters after isothermal transformation were examined in each alloy. It was concluded that the temperature region suitable for grain-refinement is below the nose of TTT diagram in nucleation-and-growth mechanism down to M_s temperature. Grain diameter from 50 to 30 μ were obtainable in such temperature region. The results suggest that similar manner is applicable for grain-refinement in any other alloy whose β–uranium decomposes to α–uranium by eutectoid reaction, as it was concluded that one of the necessary conditions for grain-refinement is the existence of nucleation-and-growth type transformation. The $\alpha \rightleftharpoons \beta$ transformation of pure uranium was concluded to be martensitic on the basis of the studies on dilute uranium alloys. The existence of martensitic mechanism is also suggested in γ-to-β transformation of uranium and its dilute alloys. (auth)

41469 SOME THERMAL AND MECHANICAL PROPERTIES OF PURE-OXIDE CERAMICS. E. S. Lukin and D. N. Poluboyarinov. Ogneupory, No. 7, 318-23(1963).

Refractoriness under a 2 kg/cm^2 load, coefficient of linear expansion (α), bending strength (σ_b), compressive strength, (σ_{comp}), and thermal-shock resistance were determined in pure-oxide sintered refractories. Samples based on alumina (Al_2O_3), zirconia (ZrO_2), magnesia (MgO), and beryllia (BeO) were compacted and fired at 1550–1950°C to form 4 × 4 × 20 mm specimens. Refractoriness-under-load and α were determined in a vacuum furnace, which is described in detail. The softening point under load was found to be: in the 1860–1930°C range for Al_2O_3-base samples and 1900°C for pure Al_2O_3 samples; in the

2250–2300°C range for pure ZrO_2 and about 2100°C for technical-grade ZrO_2-based samples; and 2300 and 2450°C for MgO and BeO samples, respectively. It is noted, however, that the figures for MgO and BeO may not be correct because of considerable vaporization in vacuum at their softening points. Linear expansion at 1800–2000°C amounted to 2–3%. Both σ_{comp} and σ_b declined rapidly at 1600–1800°C. The highest σ_b – at 1630°C and 483–505 kg/cm² was found for the pure-ZrO_2-base samples stabilized with MgO. Among Al_2O_3-base samples, those with 5% ZrO_2 had the highest σ_b (290 kg/cm² at 1630°C) and σ_{comp} (300 kg/cm² at 1800°C). MgO and BeO exhibited σ_{comp} at 1800°C of 340 and 360 kg/cm², respectively, which are the highest of all the oxide ceramics, but their σ_b were low. BeO displayed the highest thermal-shock resistance of all the oxide ceramics studied, as evidenced by σ_b, which remained practically unchanged after one 1300°C-air cycle and decreased by only 30% after one 850°C-water cycle. Samples based on Al_2O_3 with 5% ZrO_2 and on pure ZrO_2 with optimum CaO or MgO content showed the highest thermal-shock resistance of all Al_2O_3- or ZrO_2-base samples. Additions of 1% TiO_2 and 5% ZrO_2 to Al_2O_3 contributed to a decrease in sintering temperature combined with an increase in thermal-shock resistance. (TCO)

41470 LATTICE PARAMETERS OF TERBIUM AND ERBIUM AT LOW TEMPERATURES. F. J. Darnell (E. I. du Pont de Nemours and Co., Wilmington, Del.). Phys. Rev., 132: 1098-1100(Nov. 1, 1963).

Lattice parameters were determined for terbium between 300 and 77°K and for erbium between 300 and 10°K. The temperature dependences of the hexagonal c axis for both elements are in qualitative agreement with a strain dependent on $M \cdot M$, the scalar product of the moments of adjacent planes of ferromagnetically coupled spins. Below its temperature of ferromagnetic ordering, 220°K, terbium shows an orthorhombic distortion similar in magnitude to that observed previously for dysprosium. The distortion corresponds to an expansion along b or $[10\bar{1}0]$, the easy direction in terbium. (auth)

41471 THERMIONIC EMISSION OF LEAD ON TUNGSTEN AND RHENIUM. M. S. Chupakhin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Analit. Khim., 18: 1059-62(Sept. 1963). (In Russian)

The importance of magnesium and boron oxide films placed on the reflector surface of a three-filament ion source that permits obtaining intense lead ionic currents with microgram samples at a temperature of 1100°K was found. It was established that when rhenium ionizers are used instead of tungsten the yield of lead ions is about seven times higher. The yield of lead ions can be increased 1.5×10^3 times by coating the analyzed lead samples with magnesium and boron oxides and by using a rhenium ionizer instead of a tungsten one. (auth)

41472 THE ROLE OF SURFACE PHENOMENA IN METALLURGY. V. N. Eremenko, ed. Authorized Translation from the Russian. New York, Consultants Bureau, 1963. 148p.

Twenty-seven articles are included; separate abstracts were prepared for four. The remaining 23 articles not abstracted in NSA include information on: surface tension of specific metals; methods and apparatus for determination of surface tension; kinetics and rate of infiltration of specific metals; mechanism and kinetics of the process of high-temperature self-healing of defects on crystal surfaces; effects of thin coatings of surface-active metals on structural and mechanical properties; and investigation of relative surface activities by internal friction method. (P.C.H.)

41473 PHYSICOCHEMICAL BASES OF THE FORMATION OF CERMETS. V. N. Eremenko (Kiev State Univ.). p.1-8 of "The Role of Surface Phenomena in Metallurgy." New York, Consultants Bureau, 1963.

Methods of controlling the degree of wetting of surfaces of highly refractory oxides with liquid metals were investigated. The experimental variation of wettability is explained on the basis of a theoretical analysis. To ensure a strong bond at the metal–oxide boundary in cermets it is necessary to ensure good wetting. Wetting, which increases with the temperature, was found to be improved if oxides with high electrical conductivity and relatively low free energies of formation are used. The bond becomes stronger if a metal with a high affinity for oxygen is used as a cementing material. If the metal and the oxide chosen for the cermet do not have the necessary wettability and adhesion at the interphase boundary, an interphase-active element must be added to promote adhesion. Two types of additional elements can be used to promote adhesion: those with an affinity for the cation of the oxide (metal ion) and those with an affinity for oxygen. It is shown that the wetting of oxides by liquid metals and adsorption at the metal–oxide boundary must be considered to be chemical interactions. (P.C.H.)

41474 SURFACE PHENOMENA IN TERNARY METAL SOLUTIONS. P. P. Pugachevich and V. B. Lazarev (Kurnakov Inst. of General and Inorganic Chemistry, USSR). p.24-30 of "The Role of Surface Phenomena in Metallurgy." New York, Consultants Bureau, 1963.

Surface phenomena in ternary systems were analyzed on the basis of the Semenchenko molecular theory of surface phenomena. The surface tension of ternary Hg–Cd–K and Hg–Cd–Cs solutions at 22°C was measured and the magnitude of adsorption and the limit surface activity of the dissolved components was calculated by graphic differentiation. It is demonstrated that Semenchenko's molecular theory of surface phenomena in solutions can be applied to ternary metal solutions. Comparison of the results obtained in the study of ternary metal solutions with the results obtained in the study of buffering phenomena in ternary nonmetal solutions confirmed the main conclusions of the Semenchenko molecular theory of surface phenomena, that adsorption processes are common in solutions of different types. (P.C.H.)

41475 APPROXIMATE CALCULATION OF SURFACE ENERGY OF SOME CARBIDES AND NITRIDES WITH A LATTICE OF THE NaCl TYPE. S. N. Zadumkin (Kabardien-Balkarsk Univ., USSR). p.33-6 of "The Role of Surface Phenomena in Metallurgy." New York, Consultants Bureau, 1963.

The surface tension of different faces of V, Ti, and Zr carbides and nitrides were calculated using approximate calculations based on the distribution of the energy of the crystal lattice over the bonds of closest neighbors. Data are tabulated. (P.C.H.)

41476 RELATIONSHIP BETWEEN THE VOLUME AND SURFACE PROPERTIES OF METALS AND ALLOYS. V. K. Semenchenko (Moscow State Univ.). p.9-13 of "The Role of Surface Phenomena in Metallurgy." New York, Consultants Bureau, 1963.

The effects of additional elements on the surface and volume properties of alloys and metals is discussed in regard to the relation between the volume and surface properties. (P.C.H.)

41477 TEST APPARATUS AND TENSILE PROPERTIES OF Nb–Zr SUPERCONDUCTOR ALLOY WIRE IN THE TEMPERATURE RANGE 300 TO 4.2°K. D. K. Fox and W. H. Pryle (Westinghouse Electric Corp., Pittsburgh). 19p. (CONF-176-11)

From Cryogenic Engineering Conference, Boulder, Colo., Aug. 1963.

Test apparatus and techniques for testing fine wires in the temperature range of 4.2 to 300°K were developed. These were successfully applied to an investigation of the tensile properties of Nb–Zr superconductor-alloy wires. Cold drawn wires of 0.005 and 0.010 in. diameter were found to have exceptionally high strength and to retain good ductility at temperatures as low as 4.2°K. The properties exhibited are well in excess of those currently required for superconductor solenoids. (auth)

41478 NUCLEAR FUEL ELEMENT. (to Zentralinstitut für Kernphysik). French Patent 1,291,909. Mar. 19, 1962. Filed May 19, 1961.

The application of a metal foam consisting of U or a U–Zr, –Mo, –Nb, or –Cr alloy as a nuclear fuel is discussed. The foam is prepared by decomposition at 400–800°C of the corresponding hydrides. The foamy fuel is stated to be resistant to swelling even at a high burn-up. (NPO)

41479 CERAMIC FUEL FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,299,348. June 12, 1962. Priority date Sept. 5, 1960, Great Britain.

A method is described for manufacturing UO_2–PuO_2 compacts by mixing a solution of plutonyl nitrate in hexone with an organic binder, such as polybutyl methacrylate, and a plastifier, such as dibutylphtalate, adding UO_2 powder, drying and granulating the mass, and finally compacting and sintering the powder. Other solvents, binders, and plastifiers are mentioned. (NPO)

Radiation Effects

Refer also to abstracts 41118, 41190, and 41521.

41480 (AAEC/E-109) THE EFFECT OF NEUTRON IRRADIATION ON BERYLLIUM METAL. B. S. Hickman and G. T. Stevens (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). June 1963. 42p.

A summary is given of all the results obtained to date from a programme on the effects of neutron irradiation on the properties of beryllium metal. Results are presented on changes in density and mechanical properties in material fabricated by various routes and irradiated to fast neutron doses from 10^{19} to 6×10^{20} nvt and at temperatures in the range 75 to 700°C. Summaries of electron microscopy observations and electrical resistivity measurements, which are reported in more detail elsewhere, are also given. It is concluded that all the observed property changes can be interpreted in terms of the distribution of helium which is produced by fast neutron transmutation reactions in beryllium and that damage due to defect production is negligible for irradiation temperatures of 75°C and above. Density changes due to helium bubble formation are shown to be very small but serious deterioration of mechanical properties can occur. The mechanical property changes and the distribution of helium are shown to be very dependent on material history and on the irradiation temperature. The standard Lucas Heights hot extruded material is shown to retain good mechanical properties for irradiation temperatures above 550°C but serious loss of low temperature ductility is found to occur for irradiation temperatures below 500°C, particularly in the range 300 to 500°C. It is concluded that nucleation of gas bubbles at precipitate particles is the only satisfactory explanation of the wide variations in behavior of beryllium metal fabricated by various methods. (auth)

41481 (AAEC/TM-213) THEORETICAL ESTIMATES OF THE FAST NEUTRON ELASTIC SCATTERING RATE IN SOME SMALL IRRADIATION SPECIMENS. B. R. Lawrence (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Sept. 1963. 13p.

Order-of-magnitude estimates of the fast neutron elastic scattering rate have been obtained to supplement metallurgical studies of the fast neutron damage in some small beryllium oxide-based dispersed fuel specimens. The elastic scattering rate for neutrons with energies above 0.1 Mev is shown to be of the order of 30% of the fission neutron release rate in the specimens, owing to significant fast neutron leakage. The ratio of the Be (n,2n) reaction rate to the fission neutron release rate in the specimens is of the order of only 6% of its value for an infinite medium of BeO. (auth)

41482 (AD-288562) MATERIALS— TANK SEALANTS— IRRADIATION OF TWO FLUXES AND ONE TEMPERATURE— EFFECTS OF. H. M. Price (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Nov. 2, 1962. Contract AF33(657)-7248. 14p.

The effects of nuclear radiation at 2 fluxes (10 hr at 100 and 20 hr at 500 kw) and at 72 to 95°F on the hardness, tensile strength, % elongation, peel strength, and thermal rupture properties of four high temperature sealants (EC-1520, -1605, -1612; IE-1240) and one prefabricated fillet material (PR-1422) were determined. (auth)

41483 (AD-288936) MATERIAL–EFFECTS OF NUCLEAR RADIATION ON CERTAIN FUEL TANK SEALANTS AND PRESSURE SEALANTS. H. M. Price (General Dynamic/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Nov. 2, 1962. Contract AF33(657)-7248. 28p.

Studies were made to determine effects of nuclear radiation at ambient reactor temperature (without fuel immersion and during fuel immersion) upon specific physical properties of 3 sealing compounds, (EC-1610, EC-1520, PR-1422), and 7 other materials. The greatest change in physical properties occurred during irradiation at flux 2 (3000 kw, 20 hr). Of the fuel tank sealants, EC-1520 appeared the least affected by nuclear radiation. Of the other materials, a carbon black material appeared to be the least affected by radiation. (auth)

41484 (AD-292307) RADIATION-RESISTANT FLIGHT CONTROL SYSTEMS. Progress Report, September 1, 1962 through September 30, 1962. L. Roth (Northrop Corp. Northrop Space Labs., Hawthorne, Calif.). Dec. 20, 1962. 4p.

The radiation environment is being defined. Penetration of radiation through the satellite walls was determined. A theoretical study on the distribution of recoil atoms was initiated on the basis of an experimental solid-state correlation program. Analytic expressions for transistor electronic characteristics were derived as a function of geometry and material parameters. (M.C.G.)

41485 (AFCRL-62-788) ANNUAL SUMMARY REPORT NO. 1. P. Baruch (Paris. Université. École Normale Supérieure). July 25, 1962. Contract AF61 (052)-543. 16p. (AD-292762)

Three papers are included and separate abstracts are presented for two papers; the third paper was previously abstracted in NSA. The paper already abstracted is on the radiation enhanced diffusion in silicon. (N.W.R.)

41486 (AFCRL-62-788(p.10-13)) DESIGN OF A MICROCALORIMETER. STORED ENERGY MEASUREMENT IN IRRADIATED GERMANIUM. J. Zizine (Paris. Université. École Normale Supérieure).

A cryostat and calorimeter are designed for a stored energy measurement in germanium irradiated at 20°K by 2 Mev electrons. Problems of heat transfer and insulation are discussed. (auth)

41487 (AFCRL-62-788(p.14-16)) STUDY OF DEFECT MOBILITY IN IRRADIATED GERMANIUM. Edith Davoust (Paris. Université. École Normale Supérieure).

Radioinduced defects were shown, in former work, to drift in the electric field of a p-n junction, irradiated with electrons or gamma rays. The same effect occurred with neutrons. An improved capacitance bridge was used. Problems of sample preparation were summarized. (auth)

41488 (CEA-2284) MESURE QUANTITATIVE DES GAZ DE FISSION PAR SPECTROMETRIC GAMMA. [Quantitative Measurement of Fission Gases by Gamma Spectrometry). M. Blondel (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). A. Schurenkamper and A. M. Tachis (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Grenoble). 1963. 9p.

The fission gases given off by uranium oxide strongly heated after irradiation can be measured quantitatively by absorption in active charcoal traps, these traps being introduced into hollow sodium iodide crystals which are previously energy-calibrated. For a given type of crystal, the results are reproducible from one crystal to another and depend very little on the geometry of the source. The validity of the method is confirmed by comparing the results of measurements with those predicted by theory. (auth)

41489 (CRDC-1153) THE EFFECT OF OXYGEN: URANIUM RATIO ON THE THERMAL CONDUCTIVITY OF URANIUM OXIDE DURING IRRADIATION IN PELLET ROD MARK V. R. C. Hawkings and A. S. Bain (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1963. 67p. (AECL-1790)

Three aluminum-sheathed, uranium-oxide-fueled, cartridges were irradiated one above the other in the NRX reactor. The top and bottom cartridges contained $UO_{2.0}$, while the center one contained $UO_{2.19}$. Temperatures up to 1475°C were recorded by thermocouples in the $UO_{2.0}$. The thermocouple in the $UO_{2.19}$ failed early in the irradiation after recording a temperature of ~500°C. During the first irradiation cycle the thermal conductivity of the $UO_{2.0}$ was 0.055 W/cm°C at 300°C and 0.045 W/cm°C at 500°C; over the same temperature range the conductivity of the $UO_{2.19}$ was about 0.028 W/cm°C. The low temperature (300°C) conductivity of the $UO_{2.0}$ decreased with increased irradiation, whereas the conductivity of $UO_{2.0}$ at higher temperature (700°C) was essentially the same as that for unirradiated material, to an irradiation of 10^{19} fissions/cm^3. The exposure of bulk $UO_{2.0}$ to water vapor and subsequently to oxygen at 269 cm Hg resulted in no significant change in the thermal conductivity of $UO_{2.0}$. Post-irradiation examination showed no discernible grain growth in the $UO_{2.0}$, whereas the non-stoichiometric uranium oxide had extensive central melting. For the $UO_{2.19}$ a value of $O\int_0^{T_m} C\,kd\theta$ of 44 W/cm was calculated. The top and bottom cartridges ($UO_{2.0}$) had expanded only 0.3% of the outer diameter. The $UO_{2.19}$ cartridge had expanded on the average 3%, and had a maximum expansion of 7.5% at the top end. (auth)

41490 (CRFD-1012) THE EFFECT OF TiO_2 AND Nb_2O_5 ADDITIONS OF THE IRRADIATION BEHAVIOUR OF SINTERED UO_2. R. D. MacDonald (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1963. 32p. (AECL-1810; EXP-NRX-3008)

Six fuel elements, three with 0.1 wt % TiO_2 in UO_2 and three with 0.4 wt % Nb_2O_5 in UO_2, were irradiated in the X-2 pressurized-water loop of the NRX reactor. These small amounts of TiO_2 and Nb_2O_5 were added to study their effects on fission gas release from the uranium oxide during irradiation. Puncture tests after irradiation showed no reduction in the amount of fission gas released when compared to pure uranium dioxide of equal density. Changes in element dimensions and behavior of the fuel were essentially the same for the additive specimens as for pure uranium dioxide irradiated at similar heat ratings. Material, probably an eutectic in the $UO_2-Nb_2O_5$ system, was found at the bottom of the central void in the most highly rated Nb_2O_5 element. Niobium had migrated to the hot central region from the cooler regions further out. (auth)

41491 (EURAEC-662) SWELLING OF URANIUM. Quarterly Report No. 10, January 1–March 31, 1963. (Mol, Belgium. Centre d'Etude de l'Energie Nucleaire). Work Performed under United States–Euratom Joint Research and Development Program. Contract 087-62-4/RDB. 20p. (R-2213)

The exact conditions for electropolishing and thinning of uranium foils were determined. Some observations by means of transmission electron microscopy of dislocations in α-uranium and of its microstructure after partial annealing are described. Some photographs of neutron-irradiated uranium are shown. The damage is observed as rows of small dots (presumably loops), which have a pronounced crystallographic orientation. (auth)

41492 (EURAEC-758) THE EFFECT OF RADIATION ON THE DUCTILE-BRITTLE TRANSITION IN PRESSURE VESSEL STEELS. Quarterly Report No. 10, April 1–June 30, 1963. E. Anderson, D. King, R. Kollrack, M. Malone, and J. Spreadborough (Battelle Memorial Inst. International Div., Geneva). July 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 095-62-12-RDS. 45p.

Progress in the preparations for the irradiation experiments and the state of the work in fields other than electron microscopy are briefly described. Transmission electron microscope studies on tensile test specimens which had been fractured at temperatures between the ambient and –190°C are reported. Series of three different grain sizes were examined. The results show a general tendency for there to be a cell structure at the higher test temperatures and for the dislocations to be less dense and more ordered at low temperatures. The effect of increasing grain size is to shift the transition regions between the structures towards lower strain values. From the configurations of certain dislocation lines some tentative deductions are made concerning the interaction of dislocations with obstacles. (auth)

41493 (EXP-NRX-70911) LONG TERM IRRADIATION OF SAP-CLAD, UO_2 FUELLED, TREFOIL BUNDLES IN THE X-7 ORGANIC COOLED LOOP. R. F. S. Robertson, H. E. Thexton, D. E. Lew, R. D. MacDonald, and K. G. Heal (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1963. 79p. (AECL-1782)

An irradiation of experimental fuel bundles of UO_2 clad in Sintered Aluminium Product (SAP) sheaths was performed in the X-7 loop in the NRX Reactor from August to November 1961. The twofold objective of this irradiation was to gain confidence in the use of such a fuel in an organic coolant and to assess the fouling problem associated with a coolant which was as "clean" as the existing technology could produce. The trefoil bundles successfully underwent an irradiation of 2400 Mwd/tU (max.). The maximum sheath temperature was 460°C in a coolant temperature of about 310°C. Surface heat fluxes were roughly 100 w/cm^2. After irradiation, a film of about 80 μm thickness was found covering the sheath over fuelled sections. The film was by weight 40% polymerized organic and 60% Fe_3O_4. The net effect of the film was to increase the pressure drop across the fuel by 50% and increase the sheath temperature by 60°C. The SAP sheath showed no effects of irradiation except for small apparent increases in diameter at two out of eighteen planes measured. The appearance of the UO_2 was similar to that of UO_2 irradiated in pressurized water loops at similar heat ratings. The stability of the fuel and the thinness of the fouling layer were encouraging indications that a successful fuel and coolant for an organic cooled reactor could be developed. (auth)

41494 (GEMP-243) COMPUTER PROGRAMS DESCRIBING COLLISION CASCADES IN BINARY MATERIALS. III. BODY-CENTERED CUBIC AND FACE-CENTERED CUBIC STRUCTURES. D. G. Besco and J. R. Beeler, Jr. (General Electric Co. Advanced Technology Services, Cincinnati). Aug. 1963. Contract AT(40-1)-2847.

The third in a series of IBM 7090 computer programs simulating radiation damage events in binary materials is described. The present work combines in one program the facility for simulating cascades in body-centered cubic and face-centered cubic structures. The computational model is similar to that used in the earlier calculations for a square planar lattice and for a wurtzite structure, with refinements in two important areas. The assumption of binary elastic collisions remains, but the collision parameters may be computed from an arbitrarily defined potential rather than being restricted to a hard-sphere approximation to the Bohr potential. In addition, the model for atomic displacement was considerably generalized. (auth)

41495 (N62-11325) RADIATION DAMAGE TO SILICON SOLAR CELLS. Quarterly Report No. 2, October 16, 1960 to January 15, 1961. J. A. Baicker (David Sarnoff Research Center, Princeton, N. J.). Jan. 31, 1961. Contract NAS5-457. 22p.

A summary of the existing data on low- and intermediate-energy radiation damage to silicon solar cells is given, including new data collected in the present study. A detailed analysis of the effects of 8.3-Mev protons is given. At this energy and with limited statistics, the difference between eleven p on n cells and three n on p cells has diminished to less than a factor of 2 compared with the factor of 7 or 8 that was observed for 1.5-Mev protons. Critical fluxes (required to cause 25% loss of efficiency) are tabulated for electrons up to 17.6 Mev, and for alpha particles at 33 and 40 Mev. (auth)

41496 (NP-13106) MATERIALY DISPERSIONNOGO TIPA DLYA POGLASHCHAYUSHCHIKH STERGNEI YADERNYKH REAKTOROV. (Dispersion Materials for Nuclear Reactor Absorption Rods). E. G. Savel'ev, K. I. Portnoi, and V. I. Nosov (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1963. 12p.

Effects of radiation ($\sim 3 \times 10^{20}$ therm n/cm^2) on nimonic type absorption material with dispersed Eu_2O_3 (up to 30 wt %) at 1000°C in air were analyzed. It was found that irradiation did not affect dimensions, microstructure, or mechanical properties. (R.V.J.)

41497 (NP-13108) ISSLEDOVANIE NEKOTORYKH PROTSESSOV V DVUOKISI URANA, DISPERGIROVANNOI V MATRITSE. (Investigation of Certain Processes of Uranium Dioxide Dispersed in a Matrix). S. T. Konobeevskii, N. F. Pravdyuk, et al. (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1963. 19p.

Metallographic and x-ray analyses were made of irradiated uranium dioxide dispersed in Al and Cu matrices. It is shown that high uranium burnup in the UO_2 structure ($\sim 1/3$ of U atoms) resulted in a reduction of the oxide lattice period from 5.46 to 5.40 kX. It was postulated that cell constant variations are related to dioxide reduction by oxygen released in fission. Data showed that irradiation stimulated UO_2 reaction with Al at low temperatures. The obtained results are in agreement with published data. (R.V.J.)

41498 (NP-13141) IRRADIATION EXPERIMENTS WITH FUEL SUSPENSIONS. M. E. A. Hermans, R. G. Sowden, and H. S. G. Slooten (European Atomic Energy Community and Keuring van Electrotechnische Materialen, N. V., Arnhem, Netherlands). May 1962. 20p.

Results are reported of irradiation experiments on aqueous slurries of PuO_2 and ThO_2–UO_2. Irradiations were carried out with a flux of $\sim 10^{12}$ $n/cm^2/sec$ to burnups of less than 20 Mwd/t, and the supernate and residue after centrifugation were characterized by α-counting, BET measurements, and microscopic observations. From the results, it is concluded that fragmentation of fissile particles is appreciably only in a dispersing medium, the amount of breakup increases with surface area, and the fragmentation rate is independent of dose rate. The mechanism of the breakup is suggested to be a dissolution or peptization after the surface has been activated by the passage of a fission fragment. (D.L.C.)

41499 (NP-13159) STUDY OF PULSED RADIATION EFFECTS ON MICROWAVE FERRITE DUPLEXERS. Report No. 4. Quarterly Report No. 4, February 1, 1963 to April 30, 1963. J. P. Scheiwe and G. R. Harrison (Sperry Microwave Electronics Co., Clearwater, Fla.). May 1963. Contract DA-36-039-SC-89113. 41p.

The operating characteristics of C-band coaxial ferrite Y-junction circulators, C-band gyromagnetic coupling limiters, C-band coaxial internal magnet isolators, and various types cable were evaluated in the Sandia Pulsed Reactor Facility. Active tests were performed in the frequency band of 5.4–5.9 Gc for CW microwave power at the component of approximately 100 milliwatts. During the radiation burst, the average transient increase in the insertion loss of the circulator is less than 0.05 db, for the limiter less than 0.1 db, and for the isolator less than 0.15 db. These transient effects are considered to be very minor. Many signal cables were evaluated. The RG-5B/U solid dielectric filled coaxial cable was considered best for the microwave signal cables. Large transient effects were observed in air filled coaxial and rectangular waveguides. Ionization in these components is the most prominent radiation effect. For radiation resistant microwave

components, air cavities and spaces should be reduced to the absolute minimum. (auth)

41500 (REIC-29) THE EFFECT ON NUCLEAR RADIATION ON METALLIC FUEL MATERIALS. A. A. Bauer, M. S. Farkas, and V. W. Storhok (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Sept. 30, 1963. Contract W-7405-eng-92. 143p.

The effect of nuclear radiation on the properties of metallic fuels, uranium, thorium, plutonium, and their alloys is one which imposes certain limitations on the use of the uranium- and plutonium-bearing materials as reactor fuels. The most pronounced effect is radiation instability, which results both from growth and swelling during radiation. These radiation-induced changes manifest themselves as dimensional changes and decreases in density. Data are presented that summarize the effect of alloying elements, radiation conditions, and prior fabrication and thermal history on dimensional-stability properties. Data summarizing the effect of irradiation on the physical and mechanical properties of these metallic fuels are also given. The most pronounced effect on the mechanical properties is similar to that observed in structural materials, that is, an increase in hardness, an increase in the yield strength, and a slight increase in the ultimate strength. A decrease in ductility is noted for all irradiations. Thorium exhibits excellent dimensional stability but does show changes in mechanical properties associated with irradiation. The better dimensional stability has been attributed to the less anisotropic crystallographic structure of thorium. A few data pertaining to the radiation effects of plutonium and plutonium alloys are also summarized. (auth)

41501 (REIC-ACCESS-65) MONTHLY ACCESSION LIST [ON RADIATION EFFECTS DATA]. Abstracts. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). July 15, 1963. Contract AF33(657)-10085. 30p. (AD-411944)

Abstracts are presented for 82 articles which were accessioned and extracted for the REIC Technical Information File during the period June 1 to 30, 1963. The abstracts are arranged according to metallic materials, space effects, ceramic materials, polymers, experimental devices and techniques, inorganic materials, facilities, organic materials, miscellaneous, and electronic equipment. (D.L.C.)

41502 (REIC-ACCESS-66) MONTHLY ACCESSION LIST [ON RADIATION EFFECTS DATA]. Abstracts. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Aug. 15, 1963. Contract AF33(657)-10085. 31p. (AD-413328)

Abstracts are presented for 74 articles which were accessioned and extracted for the REIC Technical Information File during the period July 1 to 31, 1963. The abstracts are arranged according to metallic materials, space effects, ceramic materials, polymers, experimental devices and techniques, inorganic materials, facilities, organic materials, miscellaneous, and electronic equipment. (D.L.C.)

41503 (TID-19534) DISPLACEMENT SPIKE CRYSTALLIZATION OF AMORPHOUS GERMANIUM DURING IRRADIATION. J. R. Parsons and R. W. Balluffi (Illinois. Univ., Urbana). [1963]. Contract AT(11-1)-1198(K). 42p

Thin films of metastable amorphous germanium (700 ± 100 Å thick), prepared by evaporation on rock salt, were bombarded with either fast neutrons or monoenergetic Xe^+ ions at room temperature. Subsequent examination by bright and dark field transmission electron microscopy revealed that small discrete crystallized regions (ranging up to several hundred Å in size) were produced throughout the amorphous matrix by the irradiation. The fast neutron irradiation resulted in a linear increase in the density of crystallized regions with neutron doses ranging from 0 to 5.1×10^{16} n cm^{-2} and a most probable crystallized region size of 190 Å. The monoenergetic Xe^+ ion bombardment (covering a range of incident energies) resulted in a most probable crystallized region size very closely equal to the calculated ion range for incident ion energies from 40 to 90 kev. Also, a low (< 40 kev) and high (≥ 140 kev) Xe^+ ion energy cutoff for the production of crystallized regions were observed. Other furnace annealing experiments with similar amorphous films showed that they crystallized completely near 400°C as a result of ordinary homogeneous heating. The results were explained on the basis of "displacement spike crystallization," where the concentration of kinetic energy in the displacement cascade region was capable of inducing crystallization of the amorphous structure. A body of experimental evidence was presented, which indicated, in general, that the crystallization was confined to the displacement cascade region and therefore required the intense atomic agitation characteristic of the early stages of a displacement spike. (auth)

41504 THE EFFECT OF INTERNAL RADIATION ON THE ATTENUATION DECREMENT IN ZIRCONIUM. P. L. Gruzin and A. N. Semenikhin. At. Energ. (USSR), 15: 169-71(Aug. 1963). (In Russian)

In some cases of irradiation, the damage is due to nuclear particles formed within the target material; either because a radioactive material was inserted previously or it was formed as a result of nuclear reactions. Such internal radiations may cause transformations in the material, inducing the formation of structural defects leading to a thermodynamically unstable state. This may ultimately affect the creep, heat capacity, electrical conductivity, and the phase transformation of the material. This problem was studied by measuring the attenuation decrement in Zr under the influence of internal α particles and recoil atoms. Iodide Zr containing 0.5 and 1% U and 0.02 and 0.04% B, vacuum-annealed at 700 to 800°C was used for the tests. The internal friction of the specimens was determined at low temperatures and at low deformation amplitudes. The 4.15-Mev α particles and the recoil atoms were generated by the radioactive decay of U^{238}. The internal friction, Q^{-1}, of the specimens was measured before and after exposure to liquid nitrogen temperatures, assuming that the structural defects are stored at low temperatures. In the U-containing alloys, the Q^{-1} changed uniformly but after exposure to N_2 peak was observed at 7°. In the B-containing alloy, the particles were formed by the $B^{10} + n \rightarrow \alpha + Li^7$. It was found that the radiation lowers the Bordoni-type internal friction peak in the –70°C region. The peaks might be due to the migration of vacancies under the influence of elastic stresses. (TTT)

41505 EFFECTS OF FAST-NEUTRON IRRADIATION ON THE THERMAL CONDUCTIVITY OF SILICON. ANNEALING AND RECOVERY PROCESSES. Michel Vandevyver and Halim J. Albany (Centre d'Études Nucléaires, Saclay, France). Compt. Rend., 257: 1252-5(Aug. 5, 1963). (In French)

The recovery of Si irradiated at 70°C with an integral flux of 1.2×10^{18} fast neutrons/cm^2 is followed by means of the variations in the thermal conductivity upon isochronal annealing at 400°C. The recombination process appears to

be quasi-bimolecular, and presents an activation energy of 1.0 ± 0.1 ev. (tr-auth)

41506 ENERGY STORED IN PURE IRON IRRADIATED BY FAST NEUTRONS AT 78°K. Emmanuel Bonjour and Pierre Moser (Centre d'Études Nucléaires, Grenoble, France). Compt. Rend., 257: 1256-9(Aug. 5, 1963). (In French)

The use of a very sensitive differential-enthalpy analytic device permits the observation of four internal-energy maxima in samples of pure Fe irradiated at 78°K. The study of the two primary maxima, whose profiles are quite well defined, leads to an interpretation based on the kinetics of the recovery process. This interpretation is in agreement with results obtained by electric resistivity and magnetic training in identical samples. (tr-auth)

41507 EFFECTS OF PROLONGED THERMAL TREATMENT ON THE THERMOLUMINESCENCE AND COLORATION OF VITREOUS SILICA DOPED WITH ALUMINUM AND X-IRRADIATED. Sabatino Cohen and Monique Priqueler (Compagnie Saint-Gobain, Paris). Compt. Rend., 257: 1469-72(Aug. 12, 1963). (In French)

The absorption and thermoluminescence of Al-doped x-irradiated vitreous silica varies with the atmosphere under which thermal treatment is carried out. These variations permit several hypotheses to be made concerning the nature of the centers responsible for thermoluminescence. (tr-auth)

41508 ANNEALING OF CHEMICAL RADIATION DAMAGE BY CRUSHING AND COMPRESSION. S. R. Mohanty and S. R. Upadhyay (Banaras Hindu Univ., Varanasi, India). Indian J. Chem., 1: 456-7(Oct. 1963).

Compression and crushing of irradiated crystals were found to induce recovery of chemical radiation damage and also enhance thermal annealing. (auth)

41509 GAMMA IRRADIATION OF SILICON. II. LEVELS IN N-TYPE FLOAT-ZONE MATERIAL. E. Sonder and L. C. Templeton (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 34: 3295-3301(Nov. 1963).

Measurements of the electrical properties of gamma-irradiated float-zone silicon were used to locate a number of net acceptor levels in the upper half of the forbidden gap. In material doped with less than 10^{16} donors, a level owing to a vacancy–oxygen atom pair located 0.17 ev below the conduction band is introduced at a rate comparable to its introduction in oxygen-containing material. However, in addition there is introduced a level located 0.47 ev below the conduction band in phosphorus-doped and 0.43 ev below the conduction band in antimony-doped float-zone silicon. This latter level is presumably owing to vacancy-donor complexes. Annealing above 150°C removes the deep level; further irradiation and annealing causes the reappearance of a deep net acceptor level at 0.47 ev. In irradiated and annealed silicon an additional net acceptor level at 0.21 ev below the conduction band was observed. (auth)

41510 THE BEHAVIOUR OF HELIUM IN IRRADIATED BERYLLIUM. B. S. Hickman and J. H. Chute (Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sydney). J. Australian Inst. Metals, 8: 298-307(Aug. 1963). (AAEC/TM-188)

Under neutron irradiation beryllium metal undergoes nuclear reactions that produce helium. Studies, using electron microscopy and electrical resistivity techniques, of the nucleation and growth of the helium into gas bubbles, which occur at elevated temperatures, are described. It is shown that the size and distribution of the bubbles depends to a very marked extent on material history as well as on neutron dose and temperature and it is suggested that nucleation of bubbles occurs preferentially at second phase precipitates. The distribution of the precipitate then determines the scale of nucleation and the subsequent bubble distribution. The mechanical property changes that occur on neutron irradiation are summarized and interpreted in terms of the conclusions on the distribution of helium. (auth)

41511 NEUTRON IRRADIATION EFFECTS IN SLURRIES OF ThO_2 AND UO_2 IN INHIBITED BISMUTH. G. H. Broomfield and A. F. Bartlett (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nucl. Energy, Pts. A & B, 17: 307-11(Sept. 1963). (In English)

Slurries of 10 wt % ThO_2 and UO_2 in bismuth inhibited with 0.1 wt % Mg and 0.05 wt % Zr, canned in $2\frac{1}{4}$ Cr-1% Mo steel, were studied by microexamination after holding at 500°C and after irradiating to 7×10^{20} thermal neutrons per cm^2. Uranium was reduced by the inhibitors, in-pile and out-of-pile, to form UBi_2 and a uranium–bismuth–zirconium alloy, in the UO_2 slurry. Uranium-233 bred in the ThO_2 slurry was reduced and concentrated by mass transfer processes, while the ThO_2 was unattacked. Steel corrosion inhibition broke down in the in-pile ThO_2 slurry can. (auth)

41512 IRRADIATION SOURCE IN THE INSTITUTE OF RUBBER AND PLASTICS TECHNOLOGY. Josef Simorda. Jaderna Energie, 9: 285-92(1963). (In Czech.)

The design, construction, and operation of a Co^{60} radiation source with nominal activity of 2000 C is described. Attention was also given to the dose distribution in the irradiation chamber at various source disposing geometry. (auth)

41513 EFFECT OF NUCLEAR RADIATION ON THE PROPERTIES OF CONSTRUCTION STEEL. P. H. J. Simonis. R.C.N. (Reactor Centrum Neder.) Mededel., No. 8, 1-131(1963). (In Dutch)

The construction of steel pressure vessels for reactors presents special problems of construction and inspection. The work of the Dutch group assigned to this study and its cooperation with various international groups is indicated. Theoretical considerations on the effect of ionizing radiation on the properties of construction steel are reviewed. Experimental data on the nature of the modifications occurring as a result of fast neutron irradiation are reported. 74 references. (J.S.R.)

41514 LUMINESCENT COMPONENTS INDUCED IN MATERIALS BY 20-Mev ELECTRONS. W. C. Dickinson and A. F. Lauzon (Univ. of California, Livermore). Nucleonics, 21: No. 9, 60; 62; 64(Sept. 1963). (UCRL-6965)

Luminescent qualities of scintillators, Cherenkov radiators, light pipes, and ultraviolet-transmitting photomultiplier-tube windows should be known when they are to be exposed to ionizing radiation. Ten transparent meterials are examined, both plastic and liquid scintillators as well as several nonscintillators, for luminescence in the microsecond to millisecond region when irradiated by 2-μsec, 20-Mev, 150 ma rectangular electron pulses. (R.E.U.)

41515 CRITICAL FACTORS IN THE INTERPRETATION OF RADIATION EFFECTS ON THE MECHANICAL PROPERTIES OF STRUCTURAL METALS. R. G. Berggren. Welding Res. Council Bull. Ser., No. 87, 1-6(Apr. 1963).

The effects of fast and slow neutron exposure, neutron energy spectrum, instantaneous neutron flux, temperature,

stress, environment, lattice type, alloying elements, metallurgical structure, and test parameters on ultimate tensile strength, yield strength, elongation, and ductile brittle transition temperature of structural metals are discussed. The metals studied include carbon steels, low alloy steels, stainless steels, Ta, Ni, Zr, and Al alloys. (Rev. Metal Lit., Vol. 20, No. 10)

41516 THE INFLUENCE OF BETATRON RADIATION ON THE DIELECTRIC PROPERTIES OF CERTAIN ELECTRICAL INSULATING MATERIALS. K. A. Vodop'yanov, B. I. Vorozhtsov, G. I. Potakhova, et al. p.308-18 of "Elektronnye Uskoriteli." Tomsk, USSR, Tomsk University, 1961.

The temperature and frequency characteristics of electrical insulating materials were investigated before and after γ-irradiation at dosages ranging from 10^4 to 2×10^5 rads with a dosage rate ranging from 300 to 1300 rads/minute at temperatures of –60, –20, and +60°C and under tropical conditions (40°C and relative humidity of 98%); the source of radiation was a 15 Mev betatron. The characteristics of polyethylene were not altered by a radiation dose of 10^5 rads (the measurements were made at about 10^9 c/s). The low-frequency tan δ of plastic increased (particularly after irradiation under tropical conditions and at –60°C) but the value in the frequency range 10^5–10^8 c/s did not alter. Evidently irradiation increases the resistive component of loss by conductivity and does not alter the relaxation components. In the case of textolite with a silicoorganic binder, a dosage rate of 500 rads/min first increased the low-frequency tan δ only up to about 10^5 rads, and then diminished it. Above 1200 rads/min the tan δ steadily decreased. In silicoorganic resins, dosage rates of 500 rads/min and a dosage of 10^5 rads caused a small increase in conductivity and tan δ at low frequency, but this disappeared as temperature curves were being taken, so that the shape of the reverse temperature curve coincides with that for the non-irradiated material. Irradiation of varnishes and steatite ceramic under various conditions caused no change in their electrical insulating properties. (TCO)

41517 EQUIVALENCE OF RADIATION PARTICLES FOR PERMANENT DAMAGE IN SEMICONDUCTOR DEVICES. Richard R. Brown (Boeing Co., Seattle). New York, Institute of Electrical and Electronics Engineers, 1963, Preprint Paper 63-1109, 23p. (CONF-1-26)

From Institute of Electrical and Electronics Engineers 1963 Summer Meeting, Toronto, June 1963.

Selected transistors and diodes were irradiated by various types and energies of dislocating radiation. Irradiation by protons at 10-Mev, neutrons of a reactor spectrum, electrons at 5, 10, and 25-Mev, gamma rays from Co^{60}, and bremsstrahlung from stopping of 5-Mev electrons are discussed. Passive and dynamic monitoring of permanent radiation damage was performed for exposures ranging from "threshold" to failure doses, utilizing various exposure rates. Changes in transistor forward current gain and changes in diode lifetime are presented in terms of integrated "particle" flux. From such analysis, the feasibility of ascribing an equivalence of radiation particles for permanent damage in transistors and diodes was successfully shown. Comparative damage curves, correlations of operational degradation with defect densities, and preliminary equivalences are presented. (auth)

41518 EFFECT OF ELECTRON IRRADIATION ON MECHANICAL PROPERTIES OF ALUMINUM SINGLE CRYSTALS AT 80°K. K. Ono, M. Meshii, and J. W. Kauffman (Northwestern Univ., Evanston, Ill.). 33p. (CONF-49-3)

From International Symposium on Unit Process in Hydrometallurgy, Dallas, Feb. 1963.

Aluminum single crystals of 99.999% initial purity were irradiated at 80°K with 1-Mev electrons to total dose of $1.2 \sim 8 \times 10^{17}$ electrons/cm^2. The flow stress was measured at 77°K over the strain rate range 5×10^{-4} to 4×10^{-3} sec^{-1} and increased with irradiation. A larger increase for the higher strain rate was observed. The increase is interpreted to be due to interstitials which migrated to dislocations and were absorbed heterogeneously by making superjogs or kinks, which produce resistance to motion of the dislocations. An interruption of tensile test for a short time resulted in a yield drop which was found only in the irradiated crystals. This yield drop may be due to the Cottrell locking of the interstitial which were freed from impurity trapping sites by glide dislocations. Annealing at room temperature resulted in recovery of the hardening caused by the irradiation. Migration of vacancies or divacancies to the dislocation having interstitial jogs may produce the recovery. (auth)

41519 DAMAGE IN MOLYBDENUM ASSOCIATED WITH NEUTRON IRRADIATION AND SUBSEQUENT POST-IRRADIATION ANNEALING. B. Mastel. 12p. (CONF-168-2)

From 21st Annual Meeting of the Electron Microscope Society of America, Denver, Aug. 1963.

Molybdenum containing carbon was studied in an attempt to establish the combined effect of impurity content and neutron irradiation on the properties and structure of specific metals. Molybdenum foils were punched into discs and heat treated in vacuum. They were then slow-cooled and irradiated. After irradiation and subsequent decay of radioactivity to a low level the foils were subjected to x-ray diffraction measurements. Cold-worked foils with less than 10 ppm carbon showed no change in microstructure due to irradiation. Molybdenum foils that were annealed prior to irradiation showed spot defects. In foils containing up to 500 ppm carbon, it was concluded that the small loops present after irradiation are due to the clustering of point defects at interstitial carbon atoms, followed by collapse to form a dislocation loop. The amount of lattice expansion after irradiation was strongly dependent on impurity content. Neutron irradiation was found to reduce the number of active slip systems. (M.C.G.)

41520 TRANSIENT CONDUCTIVITY IN CAPACITOR DIELECTRICS FOR GAMMA RADIATION PULSES. H. W. Wicklein, H. Nutley, and J. M. Ferry (Boeing Co., Seattle). New York, Institute of Electrical and Electronics Engineers, 1963, Preprint Paper 63-1186, 26p. (CONF-1-25)

From Institute of Electrical and Electronics Engineers 1963 Summer Meeting, Toronto, June 1963.

Gamma, electron and x-ray induced transient conductivity in mylar, vitamin Q, fixed paper, ceramic, tantalum, and mica capacitors was measured at radiation rates from 10^6 to 10^9 r/sec and radiation pulse widths from 0.2 μsec to 11 msec. Results were interpreted in terms of design parameters for a radiation equivalent circuit. Techniques for experimental measurement of the design parameters are discussed. Data are combined with results by other investigators to provide a state-of-the-art summary of dielectric data applicable to the prediction of transient radiation effects in capacitors. (auth)

PHYSICS

General and Miscellaneous

41521 (AD-419705) P-N JUNCTION FORMATION TECHNIQUES. Quarterly Technical Progress Report No. 3, May 20, 1963–September 1, 1963. (Ion Physics Corp., Burlington, Mass.). Contract AF33(657)-10505. 47p.

Investigations were continued on spectral response as a function of junction depth in p-on-n-type cells. A further blue shift was observed with lower implantation energy (100 kev), the equal photon relative response curve peaking at 6000 Å. Graphically determined values of minority carrier diffusion lengths in the surface region show a trend towards values equalling junction depth for low-energy implanted cells. Base diffusion lengths (~40 μ) indicate a need for better starting material to obtain more efficient cells. An empirical curve that gives the relative efficiencies under solar and tungsten light (140 Mw/cm^2 incident) as a function of implantation energy was obtained. This curve shows good agreement with values predicted from spectral response curves. Results of profile investigations were inconclusive due to sheet resistance, contact resistance and forward leakage effects. In general, cells with drift fields in the surface region had higher efficiencies than linear profile cells. P-type-cells were implanted with phosphorous ions to make n-on-p cells. The first cells produced in this manner had efficiencies greater than 5% and spectral responses similar to comparable p-on-n cells. Preliminary radiation damage studies on IPC and commercial cells were in sharp disagreement with results of other workers. This was apparently due to environmental effects on radiation damage rates, but further effort is required to obtain definite conclusions. (auth)

41522 (AFCRL-62-550) THE HYDROMAGNETIC WAVE TUBE: THEORETICAL INVESTIGATION OF MODE STRUCTURES. D. J. Decourcy, Jr. and M. H. Bruce (Air Force Cambridge Research Labs., Laurence G. Hanscom Field, Bedford, Mass.). Aug. 1962. 109p. (AD-289529)

Instrumentation was designed and constructed to allow experimental investigation of ionospheric motions. This device is called the hydromagnetic wave tube. The basic modal patterns of the electric and magnetic fields under operating conditions and the propagation characteristics of these fields as functions of the static magnetic field, the ionization concentration, and the frequency of the perturbing source are theoretically determined. Brief outlines of the over-all project and the physical construction of the hydromagnetic wave tube are also included. (auth)

41523 (AFCRL-62-1047) CALCULATION OF THERMOPOWER FACTORS FOR A PLASMA AND A METAL. Scientific Report No. 3. Jack Davis and Giovanni Lanza (Northeastern Univ., Boston) Nov. 1, 1962. Contracts AF19(604)-7358 and AF19(604)-8462. 14p. (AD-293411)

The classical theory of transport phenomena, as applied to thermocouples, is developed using the Boltzmann transport equation. A comparison of the thermopower factors for a plasma and a metal, derived using Boltzmann statistics for the plasma and Fermi statistics for the electron gas in a metal, shows that the plasma thermopower factor is much larger than that for a metal. (D.C.W.)

41524 (AFCRL-63-360) POINT CHARGE CALCULATIONS OF ENERGY LEVELS OF MAGNETIC IONS IN CRYSTALLINE ELECTRIC FIELDS. Technical Note 13. M. T. Hutchings (Oxford Univ. Clarendon Lab.). Mar. 1963. Contract AF61(052)-125. 58p. (AD-418501)

An elementary account is given of the calculation of the energy levels of a magnetic ion in a crystalline electric field. As an illustration the crystalline potential due to a simple ionic point-charge model, and the corresponding Hamiltonian operator, are determined. (auth)

41525 (AFSWC-TDR-63-50) CALCULATION OF HIGH-ENERGY SECONDARY ELECTRON EMISSION. Jerry A. Sawyer (Air Force Special Weapons Center, Kirtland, AFB, N. Mex.). Aug. 1963. 176p. (AD-419306)

Thin targets of low atomic number were assumed to be bombarded with 25-Mev electrons, 600-kv x rays, and prompt fission gamma radiation. The resulting high-energy secondary electrons were calculated theoretically on a high-speed digital computer with respect to their intensity, energy losses, energy spectra, and angle of emission spectra. The results show that 25-Mev electrons, 600-kv x rays, and prompt fission gamma radiation produce a maximum efficiency of high-energy secondary-electron emission of 8.0, 0.05, and 0.3 percent, respectively. Experimental results from 25-Mev electron irradiations agree very closely with these theoretical numbers. (auth)

41526 (ANL-6720) PHYSICS DIVISION SUMMARY REPORT, JUNE 1963. Annual Review. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 120p.

Research progress in experimental and theoretical nuclear physics, theoretical high-energy physics, and extranuclear properties of matter is summarized. Accelerator operations and improvements are reported, and a list of publications is included. Separate abstracts have been prepared for the nine sections of the report. (D.C.W.)

41527 (ANL-6720(p.2-15)) RESEARCH AT THE REACTOR CP-5. (Argonne National Lab., Ill.).

Research progress on the electron-neutron interaction, decay of polarized neutrons, neutron cross sections, and neutron capture is reported. Bent-crystal and magnetic Compton spectrometers were used to obtain the neutron capture gamma spectra of samples in a CP-5 beam hole. The fast chopper was used in neutron transmission and total cross section measurements; scintillation spectrometers were also used to obtain capture gamma spectra. (D.C.W.)

41528 (ANL-6720(p.16-28)) RESEARCH AT THE 4.5-Mev VAN DE GRAAFF ACCELERATOR. (Argonne National Lab., Ill.).

The differential cross section and polarization in fast neutron scattering from Si, deuterons, Be^9, Mg, Li^6, Li^7, and Cd were measured. Polarizations in scattering from F, Na, Al, P, and K were also measured. An investigation of neutron resonances in F^{19} showed a large density of levels, most of which appear to be p-wave levels in F^{20}. The lifetimes of nuclear excited states in V^{51}, Ga^{73}, As^{75}, Rb^{85}, and Sb^{123} were measured by a pulsed-beam technique that also resolved two closely-spaced levels in Sc^{77}. Levels formed by capture of 1-4 Mev protons in B^{11} were studied. The angular distribution of the ground-state gammas from 3.48-Mev proton capture by O^{16} to form the 3.86-Mev level in F^{17} shows this level to be $^5/_2^-$. An angular distribution obtained for the $B^{11}(p,\alpha)Be^8$ reaction did not reveal the (p,α) resonance at a proton energy of 3.13 Mev. Anomalies corresponding to B^{10} states were observed in alpha scattering from Li^6. A computer program was written to calculate

the scattering of a spin-0 particle from a spin-1 target for the case of a conserved orbital angular momentum for a single level whose elastic scattering width equals its total width. Modification and operation of the accelerator are summarized. (D.C.W.)

41529 (ANL-6720(p.29-42)) RESEARCH AT THE 12-Mev TANDEM VAN DE GRAAFF. (Argonne National Lab., Ill.).

Differential cross sections for the $B^{10}(d,Li^6)Li^6$ reaction were measured, and angular distributions for alpha groups from the $K^{39}(p,\alpha)Ar^{36}$, $C^{12}(d,\alpha)B^{10}$, and $C^{13}(p,\alpha)B^{10}$ reactions were obtained. Angular distributions and absolute differential cross sections for deuteron elastic scattering and reactions (d,p) with Ca^{40} were measured. Distorted-wave Born approximation calculations fit the $Ca^{40}(d,p)$ data rather poorly, but successfully predicted the main features of the $B^{10}(d,Li^6)Li^6$ differential cross section. The validity of a set of optical model parameters for describing proton, deuteron, and alpha scattering by an optical model that represents the nucleus by an average potential was investigated. Yield curves and angular distributions for the $B^{11}(p,\gamma)C^{12}$ reaction show a broad peak at 7 Mev and structure in the giant resonance. Yield curves for $Al^{27}(p,\gamma)Si^{28}$ were also obtained. Examination of $(d,p\gamma)$ angular correlations indicates assignments of $^3/_2^-$ and $^1/_2^-$ to Ca^{41} states at excitations of 2.47 and 3.95 Mev. A uniform magnetic spectrometer, γ-γ angular correlation equipment, a 60-in. scattering chamber, and terminal bunching equipment were installed at the accelerator. (D.C.W.)

41530 (ANL-6720(p.43-7)) RESEARCH AT THE 60-IN. CYCLOTRON. (Argonne National Lab., Ill.).

The 60-in. scattering chambers were used to study 43-Mev alpha scattering by nuclei in the region from Ca^{40} to Zn^{68}, by zirconium isotopes, and by Pb^{208}. Deuteron elastic scattering at 21.4 Mev by the five stable Ti isotopes, Ca, and Pb^{206} and Pb^{208} were measured. The (d,t) reaction on Ti isotopes and (d,p) reactions with Ti, Pb, and Zr isotopes were also investigated. Nucleon pickup was studied by (d,t) and (d,He^3) reactions with F^{19}, Al^{27}, Ca^{40}, Sc^{45}, Ti^{48}, V^{51}, Cr^{52}, Fe^{54}, Fe^{56}, Mn^{55}, Ni^{58}, and Ni^{60}. Evidence for seniority mixing in Cr^{52} and Fe^{54} was obtained from (d,t) reactions, and evidence for an Fe^{54} level with an isotopic spin that is the analog of that of Mn^{53} was observed. The $Ca^{40}(d,He^3)$ reaction gave the location of the single-particle hole states in K^{39}, while (d,He^3) reactions on F^{19} and Sc^{45} show strong configuration mixing in these nuclei. Rare modes of spontaneous fission of Cf^{252} were measured. (D.C.W.)

41531 (ANL-6720(p.48-58)) OTHER NUCLEAR EXPERIMENTS. (Argonne National Lab., Ill.).

The Mark II apparatus was completed and used to investigate the hyperfine structure of Cr^{53}. The decay of Ho^{166}, Re^{188}, and W^{188} was investigated; and computer programs for the analysis of decay data were written. Pattern recognition work involved programming a computer to simulate a three-layer random connection network similar to the Perceptron. The energies of μ-mesic x rays in several elements were measured. The Mössbauer Effect in an external magnetic field, in Fe, and for Fe^{57} in metal lattices was investigated. Mössbauer studies of solid-state properties included observation of Mössbauer Effect in Xe compounds. Magnetic fields were found to produce only a slight shift of the frequency of electromagnetic radiation. (D.C.W.)

41532 (ANL-6720(p.59-66)) THEORETICAL NUCLEAR PHYSICS. (Argonne National Lab., Ill.).

Strong M1 transitions in light nuclei, seniority mixing in $1f_{^7/_2}$ nuclei, dynamics of nuclear collective motion, deformation energy of a charged liquid drop, statistical properties of nuclear energy states, and the resonance theory of nuclear reactions without boundary conditions were investigated. Computer studies of the shell model were performed, and about thirty programs for shell model calculations were developed. (D.C.W.)

41533 (ANL-6720(p.67-75)) THEORETICAL HIGH-ENERGY PHYSICS. (Argonne National Lab., Ill.).

Research progress on π-N scattering analysis, unitary symmetry in strong interactions, μ-N interactions, nucleon charge structure, elementary particle interactions, π-π scattering, representation of particles with low mass, time reversal and superselection, quantum mechanics, spin and statistics with an indefinite metric, angular distributions of decay products, the supercurrent state, and electron theory is reported. (D.C.W.)

41534 (ANL-6720(p.77-89)) EXTRANUCLEAR PROPERTIES OF MATTER. (Argonne National Lab., Ill.).

Mass spectrometric investigations of gaseous species in equilibrium at high temperatures, kinetics of chemical reactions in the gas phase, fragmentation of polyatomic molecules, consecutive ion-molecule reactions, ionization by ions in the Mev range, atomic and ionic impact of metal surfaces, and alkali salt diffusion through metals are reported. Spectrometer development is also described. (D.C.W.)

41535 (ANL-6720(p.91-4)) HIGH-FREQUENCY PLASMAS. (Argonne National Lab., Ill.).

The properties and phenomena of plasmas in uniform electric and nonuniform (resonant-cavity) electromagnetic fields at high frequencies and low pressures were investigated. (D.C.W.)

41536 (ANL-6767) PHYSICS DIVISION SUMMARY REPORT, JULY–AUGUST 1963. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 71p.

Modification and operation of the Van de Graaff accelerators are reported. The polarization and differential cross sections for neutrons scattered from Be^9 were measured at five angles for neutron energies from 0.2 to 2.0 Mev. Analysis of the data favors assignments of $J^\pi = 3^-$ ($l = 2$) for the 7.37-Mev level in Be^{10} and $J^\pi = 2^+$ ($l = 1$) for the 7.54-Mev level. A two-stage computer program was developed for the analysis of complex beta spectra comprising up to 13 components. Molecular beam investigations of hyperfine structure in Cr^{51}, Cr^{53}, Fe^{56}, and Fe^{57} were performed. Some nuclear constants for Cr^{51} and Cr^{53} were derived. Some neutron resonances in the kev region of neutron energies were restudied by flat-detection measurements, self-detection measurements, and a ratio method. Neutron cross sections and ratios for Al and Fe^{56} were measured. The 131-kev Fe^{56} level was analyzed; parameters determined for the resonance were smaller than those of other experimenters. The neutron energy spread was 0.65 ± 0.20 kev. A general-purpose computer was programmed to simulate a three-layer random connection network similar to the Perceptron of Rosenblatt. In a learning phase, many different sets of connections were tried, and the most useful ones were kept. In preliminary tests, the system showed significant (but not yet useful) discrimination in a realistic case. The calculated magnetic moment of the B^{11} ground state was found to be very sensitive to the ground-state wave function. A wave function that gives the experimental moment was constructed by generating from Nilsson wave functions. This function gave a C^{11} magnetic

moment in good agreement with preliminary measurements. The existing statistical model for nuclear energy level partial radiation widths was modified to describe such anomalies as the unexpectedly small fluctuations sometimes reported for U^{239}. (auth)

41537 (ASD-TDR-63-38) MULTI-STAGE EXPLOSIVE-MAGNETIC AMPLIFIER (FREDA). Final Report. (Utah Research & Development Co., Inc., Salt Lake City). July 9, 1963. Contract AF08(635)-3490. 42p. (AD-418506)

A satisfactory low power explosive magnetic flux amplifier (FREDA) stage was designed. The length is four in inches, and the gain is 1.4. Twenty-five stages of this type were fired without failure. Currents around 10,000 amperes and fields around 100,000 maxwells were obtained. It is proposed to construct FREDA chains long enough to run the field up to a value at which the field pressure approaches the explosive detonation pressure, and to design high efficiency high power stages. (auth)

41538 (ASD-TDR-63-500) TEMPERATURE EFFECTS ON THE REMANENCE OF PERMANENT MAGNETS. R. K. Tenzer (Indiana General Corp. Magnet Div., Valparaiso, Ind.). May 8, 1963. Contract AF33(657)-8499. 10p. (AD-420235)

Effects of temperature on the remanence of commercially produced permanent magnets were measured. Alnico II, III, IV, V, VI, VIII, Indox I and V, and Cunife magnets were investigated with regard to reversible, irreversible and material effects between –65 and +550°C. Results are shown in diagrams and tables. Alnico V, VI and VIII magnets performed best in this range. (auth)

41539 (ASD-TDR-63-748) THE EFFECT OF EMITTER WORK-FUNCTION PATCHES ON THE PERFORMANCE OF CESIUM THERMIONIC CONVERTERS. John W. Gadzuk (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). May 1963. Contract AF33(616)-7624. 48p.

An experimental program to obtain the current-voltage characteristics of a metal cesium thermionic converter with a monocrystal molybdenum emitter showing the (110) crystallographic face to cesium vapor is described and the results are presented. It is shown that the continuous linear increase in output current with decreasing output voltage or, in other words, the fact that the emission current does not show a sharp saturation value, may be due to patches of different work function on the emitter surface. It is shown that an exponential Boltzmann distribution might be expected to describe the variation in work function over the emitter surface. Also, this Boltzmann distribution may account for the shape of the current-voltage characteristics obtained from a cesium thermionic converter with a monocrystal molybdenum emitter in the region of low output voltage. From the analysis of these characteristics, the percentage area with the exponential distribution is determined. The area of the exponential patch should increase as the coverage increases. Furthermore, the experimentally determined values of the patch area decrease linearly with increasing values of the ratio of emitter temperature to cesium reservoir temperature, from which it is concluded that these patches may be caused by thermal excitation of the adsorbed layer on a nonuniform substrate. (auth)

41540 (BMI-1649) EVALUATION OF ELECTRON-EMISSION BEHAVIOR FOR DETECTING CARBON IN TUNGSTEN AND RHENIUM. James B. Baker and Gordon B. Gaines (Battelle Memorial Inst., Columbus, Ohio). Sept. 24, 1963. Contract W-7405-eng-92. 20p.

In a program to develop methods of studying high-temperature metal reactions by means of changes in the thermal-electron-emission behavior when such reactions occur, the thermal-electron-emission behavior of rhenium–carbon and tungsten–carbon alloys was determined. It is shown that the presence of a very small amount of carbon on the surface of rhenium produces an easily detectable increase in the emission current. In the tungsten–carbon system two new emission states were detected. One of these shows emission of a much higher level than that of pure tungsten and appears to occur when the emitting surface is composed of WC. The other shows an emission level slightly lower than that for pure tungsten and appears to occur when the emitting surface is composed of W_2C. (auth)

41541 (BSD-TDR-63-147) THE A. C. RESISTANCE OF NON-IDEAL SUPERCONDUCTORS. Jacob L. Zar (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). June 1963. Contract AF04(694)-33. 19p. (AD-418533)

A direct electrical measurement is made of the resistance of non-ideal superconductors at power and audio frequencies, at 4.2°K and in zero applied field. The resistance of short samples of several Nb–Zr and Mo–Re alloys is found to be independent of the composition and of impressed current. The resistivity is found to depend on $f^{0.5}$ above 1000 cps and on $f^{1.7}$ at f below 500 cps. The resistance is also independent of wire diameter for a certain range of sizes in the vicinity of 10 mil. Three explanations are considered to see if they could account for resistance at low frequencies. Relaxation time effects are ruled out by measurements at high frequencies. Inductive coupling between the magnetic fields of the normal and the superconducting currents leads to a resistance effect six orders of magnitude lower than the observed ones, and an $f^{2.0}$ dependence. Trapping of flux within the superconductor is considered, and it leads to an upper bound for the resistance that agrees with the experimental results in being independent of the wire diameter and the current, and giving the approximately correct resistance values, although an $f^{1.0}$ dependence. (auth)

41542 (BSD-TDR-63-148) CRITICAL CURRENT AND FIELD IN NON-IDEAL SUPERCONDUCTORS. A. El Bindari and M. M. Litvak (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). July 1963. Contract AF04(694)-33. 20p. (AD-417645)

The upper critical fields of the V–Ti system were measured at 4.2°K and agree with Gorkov-Shapoval's expression for the upper critical field of superconducting alloys. The critical current of samples of V with varying Ti content and also of Nb–25% Zr, all of rectangular cross-section (0.008 × 0.025 in.), was measured as a function of the magnetic field H_a applied parallel to the width of the strip. When the critical current I is plotted in units of the Silsbee current I_c (based on the thermodynamic critical field H_c), versus the applied magnetic field measured in units of the Gorkov-Shapoval upper critical field (H_2), the experimental data for all the samples tested fall on a single curve. This critical curve is deduced from the free energy of a laminar mixed state model such that the applied current flows mainly within a penetration depth along the width of the strip (end effects are neglected). The critical curve for almost the whole range of applied fields is $(I/I_c) + (H_a/H_2)^{1/2} = 1$. This condition is shown to be the same as $j_a + j_s = j_c$, where j_a and j_s are the maximum local applied and supercurrent densities, respectively, and j_c is the thermodynamic critical current density ($4\pi H_c c/\lambda$), where λ is the penetration depth. (auth)

41543 (CONF-20-23) SOME THEORETICAL ESTIMATES OF THE PHYSICAL CONSTANTS FOR THE RARE EARTH METALS. James T. Waber and Allen C. Larson (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract W-7405-eng-36. 69p.

From 3rd Rare Earth Conference, Clearwater, Fla., Apr. 21-24, 1963.

Recent determinations of the non-relativistic Hartree atomic wave functions were used to estimate which electronic configuration of the free lanthanide atoms is more stable and to make theoretical estimates of physical quantities such as the spin-orbital splitting parameters, Slater F^k integrals, diamagnetic susceptibilities, and L emission spectra. The equilibrium Wigner-Seitz radii ρ and the compressibilities χ were calculated by the Fröhlich-Raimes method. This method was extended to obtain the deviations from Vegard's law for a number of cerium based alloys. (auth)

41544 (CONF-23-20) T-MATRIX APPROACH TO ELECTRON DISTRIBUTION IN CRYSTALS. K. H. Bennemann (Illinois. Univ., Urbana). [1963]. Contract [AT(11-1)-182]. 75p.

From American Physical Society, 1963 March Meeting, St. Louis, Mar. 1963.

The wave functions for valence or conduction electrons are given in the form proposed by Phillips and Kleinman. The wave equation for the smooth part of the electron wave functions is rewritten as an integral equation that is solved by using the t-matrix formalism. The smooth part of the wave function is then given by a plane wave plus waves arising from electron scattering by the effective potential of the crystal which might contain point imperfections. Approximate expressions for the wave functions, density and energy of the valence electrons and the self-consistent crystal potential are given. Numerical results obtained for the Fourier coefficients of the valence electron charge density in diamond exhibit covalent bonding and are in good agreement with experimental results. (auth)

41545 (CONF-117-3) A PROCEDURE FOR ESTIMATING PORE VOLUME AND AREA DISTRIBUTIONS FROM SORPTION ISOTHERMS. B. F. Roberts (Oak Ridge National Lab., Tenn.). [nd]. Contract [W-7405-eng-26]. 14p.

From American Chemical Society 145th National Meeting, New York, Sept. 1963.

A rigorous procedure for calculating pore volume and area distributions from sorption isotherms was developed using the concept of simultaneous capillary condensation and multilayer adsorption. The calculations may be carried out using a computer, and the limitations of the procedure are described briefly. Results are given for several silica gel samples. (D.L.C.)

41546 (CONF-176-7) EXPERIMENTAL STUDIES ON THE CURRENT CARRYING CAPACITY OF NbZr WIRES UNDER CONDITIONS OF FIXED AND SWEPT MAGNETIC FIELD. Charles Laverick (Argonne National Lab., Ill.). [1963]. Contract [W-31-109-eng-38]. 24p.

From Cryogenic Engineering Conference, Boulder, Colo., Aug. 1963.

The current-carrying capacity of Nb–Zr wire was studied under conditions of swept magnetic field and fixed wire current and of fixed magnetic field and swept wire current. The effects of wire movement, thermal environment, copper coating of the wire, and rate of sweep of wire current or magnetic field were determined for these test conditions. (auth)

41547 (IS-617) CRYSTALLINE FIELD SPLITTINGS IN HOLMIUM AND DYSPROSIUM ETHYLSULFATES. F. H. Spedding, B. C. Gerstein, W. J. Haas, E. Phillips, and W. L. Sutherland (Ames Lab., Ames, Iowa). [Feb. 18, 1963]. Contract W-7405-eng-82. 4p.

Heat capacity measurements were carried out on Dy and Ho ethylsulfates. The observed maxima in the "zeroth order" magnetic heat capacity are discussed in relation to calculated splittings. It is believed that the results indicate a considerable effect of intermediate coupling on the ground state of Ho^{3+} and Dy^{3+} ions. (D.L.C.)

41548 (LADC-5603) ANOMALOUS HYPERFINE STRUCTURE OF DILUTE IRON IN COPPER. D. E. Nagle, W. A. Steyert, and R. D. Taylor (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-eng-36. 8p.

The magnetic hyperfine splitting of Fe^{57} nuclei present as impurities in copper metal was measured for a number of values of temperature and external magnetic field. The data, plotted on a hyperfine field vs applied field graph, show a constant H_{eff}/H slope which is temperature dependent: 1.01 ± 0.06 at 300°K, 0.965 ± 0.06 at 90°K, and 0.594 ± 0.04 at ≤ 4°K. Similar results were found for very dilute Fe^{57} in rhodium. The possible causes of the shielding of Fe from the external field are discussed briefly. (D.L.C.)

41549 (LADC-5658) SPIN-ORBIT COUPLING PARAMETERS AND SLATER INTEGRALS FOR HEAVY ATOMS. R. G. Boyd and J. T. Waber (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 17p.

Spin-orbit coupling parameters ζ and Slater integrals F^k and G^k for optical electrons were calculated from non-relativistic Hartree wave functions recently obtained by Boyd for most of the neutral atoms with $Z \geq 58$. Agreement with experiment is good for ζ_{4f} and seems moderately good for ζ_{5d} and ζ_{5f}. The Hartree values for ζ_{6d}, however, are only 50–70 per cent of experimental values. The discrepancy is attributed to relativistic contraction of the inner part of the 6d wave function. (auth)

41550 (MND-2739) METALLIC THERMOELECTRIC ELEMENTS. Final Report. William E. Kortier (Martin Co. Nuclear Div., Baltimore). June 1962. Contract AT(30-1)-2839. 65p.

Work on metallic-alloy thermoelements is described. The electrical and thermal characteristics of metallic thermoelements with thermal barriers were compared with the characteristics of elements without thermal barriers. The use of the thermal barrier configuration in these metallic thermoelectric elements apparently resulted in a marked improvement in the performance of the generator subassembly. The reason for this apparent improvement was that the ratio of element length to element area in the elements without thermal barriers was far from optimum. Adoption of the barrier principle permitted the length-to-area ratio to approach, but not reach, an optimum. The diminution of the thermal conductance of a strip of thermoelectric alloy caused by the imposition of a thermal barrier was of the same order of magnitude as the decrease in its electrical conductance. Thermal barriers had no effect on Seebeck voltages. It was concluded that introducing the thermal barrier cannot result in higher conversion efficiency. No mechanism was found to lead to an increase in the figure of merit of thermoelectric materials as a result of the imposition of thermal barriers. (M.C.G.)

41551 (NASA-TN-D-1993) MAGNETIC FIELD OF A FINITE HELICAL SOLENOID. A. R. Sass and James C. Stoll (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Oct. 1963. 44p.

A superposition principle was utilized to calculate the magnetic field distribution of a solenoid of finite length with infinitely thin walls wound with a finite helical angle. This field distribution is the vector sum of the distributions due to the azimuthal and axial components of the current density. The magnetic fields are expressed in terms of tabulated solutions of complete elliptic integrals, and they are presented in graphical form for values of helical angles from 5 to 45° and values of the ratio of solenoid length to radius from 1 to 20. (auth)

41552 (NASA-TN-D-2010) CALCULATION OF ELECTRON ENERGY DEPOSITION IN THIN-FILM POLYMERIC MATERIALS. Louis A. Teichman and Ernest S. Armstrong (National Aeronautics and Space Administration. Langley Research Center, Langley Station, Hampton, Va.). Oct. 1963. 10p.

A procedure was presented for approximating the energy deposited in shielded and unshielded polymer films by electrons entering the material normal to the surface. The analysis employs numerical methods to determine the average path length of an electron in a material for which the atomic density, atomic number, and mean excitation potential are known. It was applied to three cases, including that of the inflated Echo II balloon, with incident electron kinetic energies up to 5 Mev. Characteristic variations of deposited energy with incident electron kinetic energy were derived. (auth)

41553 (NP-13160) RESEARCH IN PHYSICS OF ELECTRON EMISSION AND ELECTRON TUBE TECHNOLOGY. Interim Report No. 1, October 16, 1962–April 15, 1963. D. E. Anderson and W. T. Peria, eds. (Minnesota. Univ., Minneapolis). Contract AF33(657)-10475. 229p.

Further experiments on the dependence of secondary yield on the angle of incidence are reported. The energy distribution of electrons transmitted through gold films is described, and progress in the theory of the production of secondary electrons is outlined. Studies of thin-film tunnel current diodes and triodes are reported; studies of hot electron injection from an electron beam into such devices are reported. Several experiments relating to BaO, (BaSr)O and BaS cathodes are described. Further results of surface studies of MgO and of the Ge : Na system are given. Some experimental results that help to clarify the bombardment induced desorption of gases from metals are presented. Two experiments on the electron emission from superconductors are described. 91 references. (auth)

41554 (NP-13166) SHOCK WAVE PROPAGATION IN SOLIDS: AN ANNOTATED BIBLIOGRAPHY. Peter R. Stromer, comp. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Mar. 1963. Contract NOw-63-0050-c. 64p. (SB-63-31)

Abstracts and references for 132 articles on shock wave propagation in solids are included. The effects of explosive blast waves and/or hypervelocity impact on plastic, viscoelastic, and elastoplastic solids are included. A detailed subject index is provided. (auth)

41555 (NP-13209) EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH ANNUAL REPORT, 1962. (European Organization for Nuclear Research, Geneva). 165p.

An account of CERN's activities in 1962 is given. Information is included on: the development and operation of the proton synchrotron, synchrocyclotron, and bubble chambers; nuclear physics; experimental and theoretical studies on elementary particles; data handling; construction on buildings and site; safety and health physics; finances and administration; publications and technical training; history and organization; and engineering and research programs. (N.W.R.)

41556 (NYO-10430) GROUND STATE OF ATOMIC HELIUM. Wilbur Lakin (New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center). July 15, 1963. Contract AT(30-1)-1480. 14p.

A variational calculation of the ground state energy is made using basic functions with the correct behavior at the simple two-electron singularities. The truncation errors obtained with few terms are not orders of magnitude less than those obtained with a spherical harmonics expansion. It seems that the slow convergence of the Legendre expansion is not due to its inability to account for this singularity with only a finite number of terms. (auth)

41557 (R62SD90) A BIBLIOGRAPHY OF RUSSIAN LITERATURE IN THE FIELD OF MAGNETOHYDRODYNAMICS. Frances Brown and Rosa Bernstein (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Apr. 1962. 143p. (AD-293273)

References (630) to articles published between 1958 and 1962 are compiled. The references are arranged alphabetically by author, and each author's work is listed chronologically. Abstracts and both original and translated citations were included when possible. (auth)

41558 (R63SD62) THEORETICAL PERFORMANCE OF MHD GENERATORS WITH VARIOUS ELECTRODE GEOMETRIES. G. W. Sutton (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Aug. 1963. Contract AF 49(638)-914. 42p. (AD-416245)

The performance of various electrode geometries was analyzed for magnetohydrodynamic generators, assuming scalar electrical conductivity and steady inviscid incompressible flow, with the following results: for electrodes whose height is less than the channel height, the electrode current is reduced, but the open circuit voltage and efficiency are unchanged, as compared to the ideal case; "wrapped around" electrodes cause internal shorting with a resulting decrease in voltage and efficiency; and finned electrodes cause less internal shorting and loss of efficiency than "wrapped around" electrodes, and may be of importance in reducing the apparent impedance of segmented electrodes for the case of tensor conductivity. (auth)

41559 (RAC-1102) MAGNETIC FIELD EFFECTS IN THERMIONIC PLASMA DIODES. Final Technical Report. Alfred Schock, William E. Eaton, Charles L. Eisen, and Bernard Wolk (Republic Aviation Corp., Farmingdale, N. Y.). Jan. 1963. Contract Nonr-3285(00). 34p. (AD-296232)

Experiments to determine the effects of transverse and longitudinal magnetic fields on thermionic current transmission are described. The results obtained are in qualitative agreement with theoretical predictions and suggest the possibility of using magnetic modulation for a-c generation. (auth)

41560 (SSD-TDR-62-121) A SIMPLIFIED THEORY OF MAGNETOHYDRODYNAMIC ISOTROPIC TURBU-

LENCE. R. Betchov (Aerospace Corp. Physical Research Lab., El Segundo, Calif.). Oct. 11, 1962. Contract AF04(695)-169. 40p. (AD-288927; TDR-169(3230-14)TR-1)

The simplest case of turbulent motion in a conductive fluid is studied. The turbulence is assumed incompressible, isotropic, homogeneous, charge invariant, and free of fourth-order cumulants. The emphasis is placed on certain integrals of the correlation functions such as kinetic and magnetic energy, vorticity, and current. A system of nonlinear ordinary differential equations is derived that governs these integral quantities. Several cases are solved numerically, illustrating the decay of ordinary turbulence, the buildup of magnetic energy by a linear or a nonlinear process, the buildup of kinetic energy, as well as the destruction of vorticity by Lorentz forces. A special hypothesis is introduced for mathematical simplicity of certain dissipative effects. A decay law is obtained. (auth)

41561 (TID-18167) TRANSFER OF EXCITATION ENERGY IN RIGID SOLUTIONS OF ORGANIC SCINTILLATORS. Louis J. Basile (Argonne National Lab., Ill.). Dec. 1962. Contract W-31-109-eng-38. 40p. (UAC-7116)

Fluorescence spectra and lifetimes were measured for solid solutions of 1,1,4,4,-tetraphenylbutadiene and p-terphenyl in polystyrene. Transfer efficiencies were obtained for the system polystyrene–1,1,4,4,-tetraphenylbutadiene. The presence of residual styrene monomer is confirmed. Results indicate that residual styrene monomer participates in the energy-transfer process both as an acceptor and as a donor molecule. Agreement was obtained between the experimental results and Förster's theory of dipole-dipole energy transfer. Values for some rate constants, quantum yields, and critical transfer distances R_0 are obtained from an analysis of the data. (auth)

41562 (TID-19506) ANGULAR AND ENERGY DISTRIBUTION OF ELECTRONS FROM GASES IONIZED BY PROTON IMPACT. Technical Status Report No. 2, July 1, 1963–September 30, 1963. M. Eugene Rudd and Carl L. Bailey (Concordia Coll., Moorhead, Minn.). Oct. 1, 1963. Contract AT(11-1)-1277. 5p.

The apparatus (and its state of development) with which the angular dependence of the differential cross section for electron ejection in the ionization of He and H by high-energy protons (up to 350 kev) is to be measured for comparison with theoretical predictions is described. (D.C.W.)

41563 (WADD-TR-60-370(Pt.III)) THERMAL RADIATION PROPERTIES OF MATERIALS. PART III. R. A. Seban (California. Univ., Berkeley. Inst. of Engineering Research). July 31, 1963. Contract AF33(657)-7793. 70p. (AD-419028)

The effect of temperature on the normal spectral emittance in the range from 1 to 15 microns is demonstrated for certain polished metals and some oxidized and coated metals by a comparison of absorptances measured at room temperature and emittances measured at temperatures of the order of 2000 to 2500°R. The emittances were obtained in a system designed and constructed in the previous phase of this research and these results are affected by the less than optimum operation of this system, by which contamination of the sample occurred, irregularly but consistently. A major diversion of effort thus occurred in attempts to ameliorate this difficulty, but without complete success. A large part of the results do appear to be satisfactory, though in this conclusion reliance must be placed on the results of other investigators to an extent greater than was first anticipated. The results for platinum, nickel, and iron reveal at high temperature the correspondence with the Hagen-Rubens law which is implied by available results on the total normal emittance, though the correspondence in this spectral range must be attributed to anomalous effects. With oxides and with coated materials the effect of temperature on the spectral values appears to be small and localized, though with some materials these are indications of permanent changes in the emittance as the period of exposure to high temperature is increased. (auth)

41564 (UCRL-10565) RANGE AND STOPPING-POWER DATA FOR HEAVY-ION EXPERIMENTERS. Henry Dakin and Roger Wallace (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 29, 1963. Contract W-7405-eng-48. 44p.

Theory for the passage of heavy ions through a medium, and its agreement with experiment, are discussed. Data on range, energy, and stopping power for heavy ions are compiled. (D.C.W.)

41565 (AEC-tr-6081) THE LIGHT YIELD AT THE EXCITATION OF LUMINESCENT ZINC SULFIDE BY β RAYS. H. J. Born, N. Riehl, and K. G. Zimmer. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Reichsber. Physik, 1: 154-8(1945). 9p.

The energy yield at the excitation of luminescent materials by ionizing irradiation had been measured until now only for α particles and for cathode rays up to approximately 50 kv of accelerating voltage. These measurements, as well as contradictory theoretical estimates do not permit a yield extrapolation in hard β-ray areas. Therefore, measurements of energy yields were carried out on Uranium X and Radium Phosphorus with β rays as well as on secondary electrons formed by the action of radium γ rays. Experimental results showed that the energy yield at the β-excitation is only slightly below the very high value found for the α-irradiation, and is higher by the factor 10 to 100 for cathode rays. This result satisfies the requirements of Fano's cathodoluminescence theory. (auth)

41566 (EURAEC-779) SCATTERING LAWS. Special Report S 10, November–December 1962. J. L. Soule (France. Commissariat à l'Énergie Atomique, Paris). 1963. Work Performed under United States–Euratom Joint Research and Development Program. 22p. (A translation)

A general model for the differential energy transfer cross section is presented that serves as the basis for the representation of scattering laws for most media. The gaseous, liquid, and solid models are considered. Development methods that permit decomposition and calculation of the differential cross section are examined, and generating functions from which the values of important integral quantities can be drawn are defined. (auth)

41567 (FTD-TT-62-1326) A THERMODYNAMIC ANALYSIS OF THE THERMAL SYSTEM OF A MAGNETO-HYDRODYNAMIC GENERATOR. D. P. Gokhshten. Translated from Teploenergetika, No. 3, 51-6(1962). 15p. (AD-292187)

A comparative analysis is made of the energy losses in an MHD installation of American design, in a vapor-gas installation of OTI-Hughes design, and in an MHD installation with a regenerative heater in which the intermediate coolant is a powder. (auth)

41568 (JPRS-21326) NEWS OF HIGHER EDUCATIONAL INSTITUTIONS MINISTRY OF HIGHER AND SECONDARY SPECIALIZED EDUCATION, USSR. RADIOPHYSICS SERIES. Translation of Izvestiya Vysshikh

Uchebnykh Zavednii, Radiofizika, 6: No. 1, 5-200(Jan.-Feb. 1963). 435p. (OTS-63-21883)

Separate abstracts were prepared for four papers on nuclear magnetic resonance, electron gas fluctuations, electron beam-electromagnetic wave interaction, and space charge wave propagation. (D.C.W.)

41569 (JPRS-21326(p.69-80)) APPARATUS FOR OBSERVATION OF BROAD NUCLEAR MAGNETIC RESONANCE LINES. V. S. Grechishkin, M. L. Zlatogorskii (Zlatogorskiy), and Yu. G. Svetlov. Translated from Izv. Vysshikh Uchebn. Zavednii, Radiofiz., 6: 36-41(Jan.-Feb. 1963).

A device for the observation of nuclear magnetic resonance in solids is described. Two transducers permit an operating range of 3 to 22 Mc. The magnet field of the electromagnet can vary from 50 to 7,000 gauss. Resonance of H^1, H^2, Li^7, F^{19}, Na^{23}, Al^{27}, Br^{81} and B^{11} have been observed. (auth)

41570 (JPRS-21326(p.104-27)) FLUCTUATIONS IN A DEGENERATE ELECTRON GAS. A. G. Sitenko and I. V. Simenog. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 6: 54-64(Jan.-Feb. 1963).

The density and particle current fluctuations in a degenerate Fermi gas are considered; the spectral distributions of the space-time correlation functions for such fluctuations are found. The dielectric constants for the electron gas are determined, using the fluctuation-dissipation theorem, from the spectral distributions of the correlation functions. The connection between the dispersion of the oscillations and the spectral distributions of the fluctuations in a degenerate electron gas are considered. (auth)

41571 (JPRS-21326(p.209-27)) USE OF THE KINETIC EQUATION METHOD IN THE INVESTIGATION OF THE INTERACTIONS BETWEEN ELECTROMAGNETIC WAVES AND THE CURVILINEAR ELECTRON BEAMS. M. I. Petelin. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 6: 104-11(Jan.-Feb. 1963).

A method proposed by Shafranor is shown to be usable for the integration of the kinetic equation in the analysis of the interaction between electromagnetic waves and curvilinear electron beams, in the case of a finite but sufficiently small electron concentration. The simplest models of systems of this type are considered. (auth)

41572 (JPRS-21326(p.228-43)) GEOMETRIC OPTICS APPROXIMATION FOR SPACE-CHARGE WAVES. N. S. Stepanov. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 6: 112-18(Jan.-Feb. 1963).

The propagation of space-charge waves in a broad straight-line electron beam, the parameters of which vary arbitrarily in space and time, is considered. In the geometric optics approximation, the variation of the amplitude, energy, form, and weak-signal spectrum is investigated; the applicability of the approximation is also examined. (auth)

41573 DIFFRACTION BY ATOMS DISTRIBUTED AT RANDOM AT LATTICE SITES. A. M. Cormack (Tufts Univ., Medford, Mass.). Acta Cryst., 16: 1051-5(Oct. 10, 1963).

A recurrence procedure is given for the calculation of the mean amplitude, its dispersion, and the mean intensity diffracted by a set of lattice sites occupied at random by atoms of various kinds. A three-dimensional lattice is treated when no correlations are present. An example (with no correlations) is given which pertains to Mössbauer scattering, and explicit formulas are given if there are only two types of atom with correlations. (auth)

41574 X-RAY SCATTERING FACTOR OF A HYDROGEN ATOM IN A HYDROGEN MOLECULE. T. Iijima and R. A. Bonham (Indiana Univ., Bloomington). Acta Cryst., 16: 1061-2(Oct. 10, 1963).

The effective scattering factor f^e of a hydrogen atom in a hydrogen molecule was evaluated. The results revealed that the magnitude of f^e is not necessarily less than that for an isolated atom, and in fact it is more in most cases. Calculations for the case where $\mu = 1$ showed good agreement with previous results. It is suggested from the results that in the analysis of x-ray scattering data, in the absence of molecular wave functions needed to calculate f^e correctly, it would be better to use x-ray scattering factors for spherical atoms rather than x-ray scattering factors calculated with a charge density function. (P.C.H.)

41575 DISPERSION CORRECTIONS FOR X-RAY SCATTERING OF ATOMS FOR AgKα AND CoKα RADIATIONS. M. J. Cooper (Cavendish Lab., Cambridge, Eng.). Acta Cryst., 16: 1067-9(Oct. 10, 1963).

Dispersion corrections for x-ray scattering of atoms for AgKα and CoKα radiations were calculated and are tabulated; values for $\sin\theta/\lambda = 0.6$ A^{-1} for CoKα radiation were included to permit the examination of values for $\sin\theta/\lambda$ between 0.4 and 0.56 A^{-1} ($= 1/\lambda$). (P.C.H.)

41576 MAGNETOHYDRODYNAMIC FLOW PAST A WEDGE WITH A PERPENDICULAR MAGNETIC FIELD. Yoichi Mimura (Cornall Univ., Ithaca, N. Y.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 2272-9(Oct. 1963).

The magnetohydrodynamic two-dimensional steady supersonic flow past a wedge with attached straight shock waves is investigated. The fluid is assumed to be nonviscous and perfectly conducting. The wedge is nonconducting, nonmagnetic, and symmetric with respect to the flow. The magnetic field is applied perpendicular to the uniform flow. The general procedure to obtain the solution with two kinds of attached straight shock waves is studied for an arbitrary Mach number (>1) and an arbitrary strength of the magnetic field. The approximate solutions for the case of weak magnetic field and for the case of the small-angle shock waves are treated. The analysis shows that the hydrodynamic shock wave does not change its position and strength in the first order of the foregoing approximation. However, when the weak magnetic field is applied, the new magnetohydrodynamic shock wave appears near the surface of the wedge, and it leaves the surface as the magnetic field increases; for a further increase of the magnetic field, it meets the hydrodynamic shock wave, and then the solution with attached shock wave disappears. For a still stronger magnetic field, the magnetohydrodynamic shock wave appears in front of the hydrodynamic shock wave. (auth)

41577 INITIAL EVALUATION OF PERFORATED ION ENGINE EMITTERS. J. J. Krauss and E. N. Petrick (Kelsey Hayes Co., Romulus, Mich.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 2393-6(Oct. 1963).

A report is given on current progress in evaluating emitters made from thin solid plates into which holes of the correct dimension are placed. Electron-beam drilling has provided the most satisfactory results for reproducibility of hole size and spacing. Inert gas flow testing preceded the high-temperature cesium flow tests. The flow conductance was measured in each case. (R.E.U.)

41578 THE STATISTICAL THERMODYNAMICS OF EQUILIBRIUM. Laszlo Tisza and Paul M. Quay (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.), 25: 48-90(Oct. 1963).

A statistical thermodynamics is developed in terms of

extensive variables (additive invariants) distributed over a cellular division in space. In general, this distribution is governed by randomness and by correlations. This theory, however, deals explicitly only with randomness, although correlations are implicit in the so-called fixed variables of the system. Because of this restriction, the theory is valid only for the fluctuations of coupled systems that have reached their equilibrium; hence it is the statistical thermodynamics of equilibrium. A set of postulates is advanced, the essence of which is the requirement that distribution functions (d.f.) exist for two basic coupling situations. It is implicit that the system has a memory-loss mechanism, and the d.f. does not depend on past history. Such qualitative assumptions are sufficient to derive the Gibbsian d.f.'s in their quantitative form. These d.f.'s describe the coupling of finite systems with infinite environments and can be used to analyze typical situations of measurement by the methods of mathematical statistics. This point of view sheds some new light on the ergodic problem and on the role of Nernst's law in completing the definition of thermodynamic equilibrium. An attempt is made to clarify the relations between entropy, information, and uncertainty by advancing a generic notion, the dispersal of a d.f., that subsumes these concepts as special cases. (auth)

41579 THE RANGE OF Kr^{85} IONS IN ALUMINUM AND TUNGSTEN IN THE ENERGY INTERVAL 2-600 kev. J. A. Davies, B. Domeij, and J. Uhler (Nobel Inst. of Physics, Stockholm and Royal Inst. of Tech., Stockholm). Arkiv Fysik, 24: 377-88(1963). (In English)

Detailed measurements of the range and range distribution of Kr^{85} ions in aluminum and tungsten were carried out, using the electrolytic peeling method, for incident Kr^{85} energies of 2 to 600 kev. The Kr^{85} distribution in aluminum shows the characteristic exponential tail observed in earlier studies. In tungsten, this tail is even more pronounced and is no longer exponential at large penetration depths. A comparison with the theory of Lindhard shows that the predicted range is always considerably smaller than the measured value, except for the high-energy data (>200 kev) in aluminum. (auth)

41580 THE RANGE OF Rn^{222} IONS OF kev ENERGIES IN ALUMINUM AND TUNGSTEN. I. Bergstroem, J. A. Davies, B. Domeij, and J. Uhler (Nobel Inst. of Physics, Stockholm and Royal Inst. of Tech., Stockholm). Arkiv Fysik, 24: 389-98(1963). (In English)

Range distributions of Rn^{222} ions for the energy interval 2 to 450 kev were measured in aluminum and tungsten using the electrolytic peeling method. In agreement with previous studies, the measurements confirm the existence of penetrating, energy-dependent tails in the observed distributions. At the highest energies used, the slope of these tails appears to be approaching a limiting value, a phenomenon which is attributed to the increased importance of electronic stopping. In aluminum, the median ranges are in reasonable agreement with the Lindhard theory, whereas in tungsten a similar comparison shows a significant discrepancy, which is ascribed to crystal lattice effects. (auth)

41581 A METHOD OF DETERMINING HEAVY ION RANGES BY ANALYSIS OF α-LINE SHAPES. B. Domeij, I. Bergstroem, J. A. Davies, and J. Uhler (Nobel Inst. of Physics, Stockholm and Royal Inst. of Tech., Stockholm). Arkiv Fysik, 24: 399-411(1963). (In English)

A method of determining the depth distribution of Rn^{222} atoms beneath the surface of a solid target by analysis of the line shape of the emitted α particles is described, and its application to the study of the range and range straggling of energetic atoms is presented. Mean range determinations in the energy interval 70 to 210 kev are given, and a comparison with ranges measured by the electrolytic peeling method shows satisfactory agreement. A discussion of the figures of merit of the method is given. It is shown that ranges of Rn^{222} ions of energies above 20 kev can be readily measured. (auth)

41582 RANGE DISTRIBUTIONS OF W^{187} IONS OF kev ENERGIES IN TUNGSTEN. J. Uhler, B. Domeij, and S. Borg (Nobel Inst. of Physics, Stockholm and Royal Inst. of Tech., Stockholm). Arkiv Fysik, 24: 413-19(1963). (In English)

Until now no measurements of complete range distributions of an ion in its own element have been made. The ranges of W^{187} ions in the energy interval 1.6 to 127 kev are measured. Comparison is made with distributions of noble gas ions in W. The data confirm the significance of the distributions obtained for ranges of gas ions. The ranges found are shown to be considerably larger than predicted by theory. (auth)

41583 THE MÖSSBAUER EFFECT. F. W. de Wette. Atoomenergie Haar Toepassingen, 5: 175-84(Sept. 1963). (In Dutch)

An elementary description is given of the Mössbauer effect. The phenomenon of resonance absorption and the different effects that γ radiation has on this phenomenon are discussed. The principle of recoil transitions on which the effect depends is then described. Possible utilizations are indicated. (tr-auth)

41584 MAGNETOHYDRODYNAMIC MOTION OF A SPHERICAL FLUID MASS IN WHICH THE CURRENT LINES ARE CIRCUMFERENCES IN PARALLEL PLANES. Maria Teresa Vacca. Atti Accad. Sci. Torino. I. Classe Sci. Fis., Mat. Nat., 97: 841-56(1962-63). (In Spanish)

The magnetohydrodynamic motion of an electrically conducting spherical fluid mass is studied under the hypothesis that the magnetic field generated by the fluid mass have, at the surface, a normal component equal to that which determines a magnetic dipole placed in the center. It is assumed that the current lines are circumferences in parallel planes and the vortex lines are at right angles. (tr-auth)

41585 A THEORY OF HELIUM II. D. B. Macleod. Australian J. Phys., 16: 323-39(Sept. 1963).

A new possible explanation of the properties of helium II is developed. The basis of the argument is that, due to the internal cohesion of a fluid, potential energy resides within the repulsive field of the atoms. This potential energy will tend to appear as kinetic energy if the fluid expands, but, under its own vapor pressure, the sum of the potential and kinetic energies will be a constant in the system and be intrinsic to it. Arguments based on this conception lead to an understanding of many of the peculiarities of helium II and also to a simple expression for the velocity of the second sound wave. (auth)

41586 CALCULATIONS OF OXYGEN ISOTOPE ABUNDANCE RATIOS IN A MASS SPECTROMETER. J. Dattner (Weizmann Inst. of Science, Rehovoth, Israel) and J. Fischler. Brit. J. Appl. Phys., 14: 728-9(Oct. 1963).

New formulas for calculating isotope abundance ratios of oxygen enriched with O^{17} and O^{18} are derived without assuming any contribution to be negligible. (auth)

41587 METASTABLE Ar^{+} IONS NEAR THE Ar^{++} THRESHOLD. J. Wm. McGowan and Larkin Kerwin (Laval Univ., Quebec). Can. J. Phys., 41: 1535-41(Oct. 1963).

When applied to the mass spectrum of argon, the tech-

niques of Aston banding and I.P. curve comparison reveal the presence of metastable states of Ar^{+} near the ionization threshold of Ar^{++}. These metastable states make possible the collision charge-exchange reaction 10/20 with an over-all cross section at 1 kev of a least 2.5 $Å^2$. (auth)

41588 STUDY OF A PROPOSAL FOR DETERMINING THE g-FACTOR ANOMALY FOR ELECTRONS BY RESONANCE EXCITATION IN A MAGNETIC FIELD. J. Byrne (Univ. of Edinburgh). Can. J. Phys., 41: 1571-9(Oct. 1963).

Following recent proposals for the experimental determination of the electron g-factor anomaly, a study was made of the properties required of a perturbing electromagnetic field for the production of particular transitions between the states of an electron moving in a constant homogeneous magnetic field. The matrix elements were calculated for the transitions of interest, and some suggestions were advanced for the solution of certain experimental problems indicated by the results of the study. (auth)

41589 NUCLEAR SPIN RELAXATION IN GASES AND LIQUIDS. II. MOLECULAR HYDROGEN. Myer Bloom (Univ. of British Columbia, Vancouver) and Irwin Oppenheim. Can. J. Phys., 41: 1580-90(Oct. 1963).

Spin-lattice relaxation times in H_2 are expressed in terms of correlation functions of the intramolecular interactions in the Schwinger model. A relationship between these correlation functions and correlation functions of the intermolecular interactions is derived. An approximate theory of the influence of higher rotational states is given. (auth)

41590 MEASUREMENT OF THE LANDÉ FACTORS AND THE LIFETIMES OF ATOMIC LEVELS OF Cd EXCITED BY ELECTRON BOMBARDMENT. Mireille Barrat and Jean-Pierre Barrat (Faculté des Sciences, Caen). Compt. Rend., 257: 1463-5(Aug. 12, 1963). (In French)

The Landé factors and lifetimes of several states of even isotopes of Cd are measured by magnetic resonance. (tr-auth)

41591 MECHANISM FOR ENERGY TRANSFER IN LIQUID SCINTILLATORS. René Voltz, Gilbert Laustriat, and André Coche (Centre de Recherches Nucléaires, Strasbourg). Compt. Rend., 257: 1473-6(Aug. 12, 1963). (In French)

A mechanism is proposed for transfer of molecular-excitation energy from solvent to solute, in liquid scintillators based on benzene and its methyl derivatives. (tr-auth)

41592 SUPERCONDUCTING MAGNETS FOR THE GENERATION OF HIGH MAGNETIC FIELDS. H. J. Goldsmid (General Electric Co. Ltd., Wembley, Eng.). G. E. C. J. Sci. Tech., 30: 114-21(1963).

The physical principles that underlie the behavior of high-field superconductors are explained, and the properties of the important superconducting materials are described. Some consideration is given, not only to low-current solenoids wound from thin superconducting wire, but also to high-current solenoids and the techniques for magnetizing them. (auth)

41593 ANALYSIS OF EXO-ELECTRON GLOW CURVES. Joseph F. Young and David J. Williams (Douglas Aircraft Co., Santa Monica, Calif.). J. Appl. Phys., 34: 3157-60(Nov. 1963).

Exo-electron glow curves for an oxide surface on aluminum have two principal peaks. The analysis supports the theory of thermostimulated exo-electrons originating in traps below the conduction band. The aluminum oxide surface had two types of traps, both approximately one electron volt below the conduction band, and attempt-to-escape frequencies of 4×10^{10} sec^{-1} and 4×10^{9} sec^{-1}. (auth)

41594 IMPROVED THERMIONIC EMITTER USING UNIAXIALLY ORIENTED TUNGSTEN. Ira Weissman and M. L. Kinter (Varian Associates, Palo Alto, Calif.). J. Appl. Phys., 34: 3187-94(Nov. 1963).

Emission from most practical electron sources is nonuniform over the emitting area. Ordinary metallic surfaces are polycrystalline and their emission comes from many different small crystal facets whose work functions can vary over a wide range of values. As an example, the range of work functions of tungsten goes from a low of 4.3 for the (116) face to a high of 5.9 ev for the (110) face. Substantially improved uniformity of work function and current density would result if the entire emitting surface contained only a single-crystal plane. The use of a single crystal as a means of obtaining such a surface is costly and wasteful since its unique bulk properties are superfluous and do not in any way contribute towards the improved performance. Even more important, using a single crystal inherently limits one to planar geometries. Many polycrystalline materials of arbitrary shape, among them the refractory metals, when prepared by chemical vapor deposition can be made to exhibit a high degree of uniaxial crystal orientation with their preferred axis centered about the direction of growth. Given proper treatment after deposition, the surface of such materials predominantly consists of a single-crystal plane. X ray, optical, and thermionic-emission measurements are described that were made on vapor-deposited tungsten prepared by the hydrogen reduction of tungsten hexafluoride. By comparing volt-ampere characteristics of high-vacuum diodes, one of which contains a conventional tungsten filament and the other a chemically vapor-deposited one, of identical dimensions, it is found that there is an expected improvement in emission uniformity owing to the uniaxial grain orientation in the latter. By a similar comparison of cesium-neutralized energy-converter diodes, it is shown that the improved surface uniformity results in significantly improved power quadrant characteristics. (auth)

41595 FOCUSING OF NEUTRAL PARTICLE BEAMS BY FICTITIOUS FORCE FIELDS. Daniel F. Dempsey (Canisius Coll., Buffalo). J. Appl. Phys., 34: 3220-3(Nov. 1963).

In a rotating coordinate system the Coriolis force and centrifugal force can account for the curved trajectories followed by moving particles. It is shown that particle trajectories diverging from a source fixed in the rotating system may come to a focus at another point fixed in the system. Both first- and second-order focusing are obtained and an example of each is given. Expressions are derived for velocity dispersion and for the transverse aberration at the focus. (auth)

41596 INDUCTIVE BEHAVIOR OF SUPERCONDUCTING MAGNETS. C. F. Hempstead, Y. B. Kim, and A. R. Strnad (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 34: 3226-36(Nov. 1963).

The inductive behavior of a closed system of superconductors is investigated with the purpose of attaining high magnetic fields. High-field superconductors do not exhibit the Meissner effect, and the inductive behavior of a system formed of these materials can be predicted fairly accurately from the conservation law of flux linkage which follows from the zero resistivity. Simple flux shielding or trapping is quantitatively analyzed for a tubular geometry. The flux concentration scheme is discussed for several practical configurations. In this scheme, a low field over a large volume (externally applied field) is compressed into a smaller volume to achieve the desired intensification in field strength. The energy of the external magnetic field

can be utilized more effectively by flux pumping, but this requires intricate switching sequences. (auth)

41597 ONE-SIDED MULTIPACTOR DISCHARGE MODES. Edward F. Vance (Stanford Research Inst., Menlo Park, Calif.). J. Appl. Phys., 34: 3237-42(Nov. 1963).

Modes of multipactor discharge occurring in a biased gap are described in which secondary emission from only one electrode is required to sustain the discharge. An analysis of these modes and an experimental corroboration of the theory are presented. (auth)

41598 SPUTTERING YIELDS OF SINGLE CRYSTALS BOMBARDED BY 1- TO 10-kev Ar^+ IONS. G. D. Magnuson and C. E. Carlston (General Dynamics/Astronautics, San Diego, Calif.). J. Appl. Phys., 34: 3267-73(Nov. 1963).

The sputtering yield S, in atoms/ion, was measured for Cu and Ag single crystals bombarded at normal incidence by 1- to 10-kev Ar^+ ions. Yields of the three low-index planes (110), (100), and (111) for Cu and Ag crystals were measured as well as that of a Cu (311) plane. In addition a yield curve of a Cu (100) crystal bombarded in a [111] direction was measured. The yields were obtained by a weight loss method using ion beam techniques. The yields are strongly dependent on crystalline orientation showing a steep rise with energy, a maximum, which appears at an energy depending on the plane being bombarded, and a slow decrease with ion energy above the maximum. A simple theory is presented which accounts reasonably well for the energy dependence of the sputtering yield in terms of crystalline opacity and the momentum of the incident ion. (auth)

41599 USE OF RESCALED EIGENFUNCTIONS AS VARIATIONAL WAVEFUNCTIONS IN CALCULATIONS ON ATOMS AND IONS. Frank O. Ellison and Norman T. Huff (Carnegie Inst. of Tech., Pittsburgh). J. Chem. Phys., 39: 2051-6(Oct. 15, 1963).

Electron-electron repulsion energies $\bar{C}$ and electron-nuclear attraction energies $\bar{L}$ were computed from the non-relativistic total energies E for isoelectronic series of two-, three-, and four-electron atoms in their lower electronic states. A limited variational approach to atomic structure is described that uses in effect rescaled eigenfunctions (for two or more electron systems) as a basis; the empirical $\bar{C}$ and $\bar{L}$ were employed in the calculations. Use of the eigenfunction for an atom with nucleus of charge Z + 1 to predict the energy of an isoelectronic system with nucleus of charge Z yields results that are in error by about 0.3 to 0.7 ev for two- to four-electron atoms, respectively. A semiempirical correction scheme of this approach gives results that are in error by 0.01 to 0.1 ev, respectively. Energies for some states of H, He, and Li negative ions are predicted. (auth)

41600 ITERATION-VARIATION PROCEDURES FOR QUANTUM-MECHANICAL PERTURBATIONS. Joseph O. Hirschfelder (Univ. of Wisconsin, Madison and Univ. of Florida, Gainesville). J. Chem. Phys., 39: 2099-2104 (Oct. 15, 1963).

The Dalgarno-Lewis procedure was used for obtaining explicit solutions to the perturbation equations. Three basic ideas were exploited: By using the wavefunction through the first order as the zeroth-order wavefunction in a new perturbation calculation, an iteration procedure that converges with surprising rapidity was obtained. After n iterations, the energy is given accurately up to terms of the order of the 2^{n+1} power of a perturbation parameter. By varying the proportions of the zeroth- and first-order functions in the wavefunction through the first order, somewhat better energies were obtained and still maintain the ability to iterate. For degenerate and almost degenerate energy levels, the wavefunctions through the first order and the energies through the third order were obtained by solving a finite-ordered secular equation. This procedure is much simpler and less apt to fail than the usual techniques. (auth)

41601 MÖSSBAUER EFFECT IN THE PEROVSKITE-TYPE COMPOUNDS $HoFeO_3$ AND $ErFeO_3$. J. Chappert and P. Imbert (Centre d'Etudes Nucléaires, Grenoble, France and Centre d'Etudes Nucléaires, Saclay, France). J. Phys., 24: 412-13(June 1963). (In French)

The Mössbauer effect in Fe^{57} is determined in Er and Ho ferrites at 77 and 290°K, and is used to calculate the internal magnetic fields at the Fe positions in these compounds at these temperatures. The magnetic moment of the first excited state in Fe^{57} is determined, as is the displacement produced by the interaction of the Fe^{57} quadrupole moment with the electric field gradient. (T.F.H.)

41602 STUDY BY MASS SPECTROMETRY OF A POSITIVE ION SOURCE USING A HIGH-FREQUENCY ELECTRIC DISCHARGE. J. C. Abbe and J. P. Adloff (Centre de Recherches Nucléaires, Strasbourg). J. Phys., 24: Suppl. to No. 6, 94A-100A(June 1963). (In French)

A mass spectrometer is equipped with a r-f ion source. A description of the arrangement is given, and the composition of the ion beam extracted from a discharge in hydrogen, deuterium, and argon is examined as a function of the gas pressure in the source. (auth)

41603 THE MÖSSBAUER EFFECT IN SOLID STATE PHYSICS. R. Fatehally (Tata Inst. of Fundamental Research, Bombay). J. Sci. Ind. Res., 22: 251-6(June 1963).

A brief review is given on data relating to the Mössbauer effect in solid-state physics with emphasis placed on point defects. The Lamb-Mössbauer factor f, the fractional intensity of the Mössbauer line, is discussed. It is shown that information regarding anharmonic lattice forces may be obtained from the temperature variation of the Lamb-Mössbauer factor for high temperatures. For substitutional point defects, information regarding the exact nature of the impurity binding may be obtained from a study of the velocity spectrum and the Lamb-Mössbauer factor. (R.E.U.)

41604 NEW DATA ON SUPERCONDUCTING ALLOYS. D. K. Fox and W. J. Reichenecker (Westinghouse Electric Corp., Pittsburgh). Mater. Design Eng., 57: 92-3(Apr. 1963).

Superconducting materials and their applications are discussed. The materials are divided into two general categories—brittle and ductile. Mechanical and physical properties of superconducting niobium–zirconium wire at various temperatures are discussed. Superconductivity temperatures and critical field strengths are given for some metals, alloys, and compounds. (R.E.U.)

41605 IONIZATION COEFFICIENTS IN HELIUM AT HIGH PRESSURES. J. Dutton, F. Llewellyn-Jones, and D. B. Rees (University Coll. of Swansea, Wales). Nature, 200: 58-9(Oct. 5, 1963).

Preliminary measurements on the pre-breakdown ionization currents in uniform fields in helium over the range $3 < E/p < 5v\ cm^{-1}\ mm\ Hg^{-1}$ for pressure between 150 and 560 mm Hg are reported. The measurements were carried out using a specially designed parallel plate ionization chamber with electrode separation variable from 0 to 1.5 cm. Results are presented in graph form. (M.C.G.)

41606 ENERGY OF AN ATTRACTIVE FERMI GAS AT LOW DENSITY. M. Gaudin (CEN, Saclay, France). Nucl. Phys., 46: 417-36(Aug. 1963). (In French)

The energy of a Fermi gas with attractive interaction is expressed in terms of the scattering length a and the Fermi momentum k_F, in the low density limit. The aim of this calculation is to give simultaneously the dominant part of the normal and superconducting contribution as a function of ak_F. (auth)

41607 RADIONUCLIDE POWER FOR SPACE. PART 3. GENERATOR PERFORMANCE AND MISSION PROSPECTS. Fred Schulman (National Aeronautics and Space Administration, Washington, D. C.). Nucleonics, 21: No. 9, 54-8(Sept. 1963).

Future prospects for isotope power in space and the status of the technology upon which these prospects are based are pointed out. Generator needs and performance in space are discussed with examples of present missions cited. (R.E.U.)

41608 AN "OPEN SHELL" TYPE WAVE FUNCTION FOR THE HYDROGEN MOLECULE GROUND STATE. L. Oleari and G. Giacometti (Università, Padua). Nuovo Cimento (10), 29: 771-6(Aug. 1, 1963).

The energy of the H_2 molecule is calculated by using an open-shell function analogous to the one used by Hylleraas for the He atom. In this way radial correlation is introduced without explicit inclusion of terms containing the interelectron distance r_{12}. The calculated dissociation energy (4.17 ev) is one of the best values obtained in this approximation. A comparison with a similar wave function suggested by Müller and Eyring is made. (auth)

41609 A NEW METHOD OF COMPUTING THE OPTICAL POLARIZABILITY OF THE HYDROGEN ATOM. M. N. Adamov, V. K. Kogan, and B. I. Orlov. Opt. Spectry. (USSR) (English Transl.), 14: 391-4(June 1963).

An integral representation of the dispersion formula for hydrogen atoms and one-electron ions is derived. By means of this representation, the optical polarizability of the hydrogen atom in the ground state and the lower excited states is computed for various light frequencies. A frequency is found for which light passes through atomic hydrogen without refraction. (auth)

41610 PULSATIONS IN THE SPECTRUM OF STIMULATED EMISSION OF NEODYMIUM IN GLASS. A. M. Bonch-Bruevich, Ya. E. Kariss, and P. P. Feofilov. Opt. Spectry. (USSR) (English Transl.), 14: 438-9(June 1963).

Some results are presented of a study of the time behavior of the stimulated emission from neodymium glass in different spectral regions. The emission was excited by a xenon flash lamp. Optical glass, glass fibers, and inhomogeneous massive glass samples were used in the experiment. (R.E.U.)

41611 STATISTICAL DERIVATION OF HYDRODYNAMICS FOR A COULOMB SYSTEM. Allan N. Kaufman (Univ. of California, Livermore and Princeton Univ., N. J.). Phys. Fluids, 6: 1574-8(Nov. 1963). (MATT-190)

The equations of hydrodynamics, derived by Irving and Kirkwood for short-range interactions, are derived for a classical system with Coulomb interactions. The stress tensor, energy density, and energy flux density each consist of a kinetic term, a self-consistent field term, and a correlation term. The correlation terms are meaningful for systems whose correlation length is small compared to the macroscopic scale of length. No restriction is placed upon the density of the system, nor upon the time scale. (auth)

41612 OSCILLATIONS OF A CAPILLARY JET OF FINITE ELECTRICAL CONDUCTIVITY IN THE PRESENCE OF A UNIFORM AXIAL MAGNETIC FIELD. N. K. Nayyar and S. K. Trehan (Univ. of Delhi). Phys. Fluids, 6: 1587-90(Nov. 1963).

An investigation is made for general perturbations. The dispersion relation is obtained and examined under various limiting cases of electrical conductivity; in particular, for the case of high resistivity an approximate formula for the frequency of oscillations of the jet is obtained. It is found that for nonaxisymmetric perturbations, the modes of oscillation of the jet are always stable and damped. The damping constant of the oscillations for different values of the wavenumber are tabulated for the case m = 1. (auth)

41613 ENERGY DENSITY IN A DISPERSIVE MEDIUM FORMULATED IN TERMS OF CONSTITUTIVE AND "ELECTROMAGNETIC" PARAMETERS. J. Neufeld (Oak Ridge National Lab., Tenn.). Phys. Letters, 6: 246-7 (Sept. 15, 1963). (In English)

A modified phenomenological formulation is used to eliminate distinctions between frequency-dispersive and space-dispersive media. A unified treatment, which is applicable to both types of dispersive media, leads to a new formulation for the energy density in a space-dispersive medium. The use of electromagnetic parameters is convenient in the description of space-dispersive media since these parameters provide a representation which is independent of the vector characterizing the space dispersion. (R.E.U.)

41614 CALCULATIONS ON THE LOW TEMPERATURE SPECIFIC HEAT OF BISMUTH. L. S. Kothari and V. K. Tewary (Univ. of Delhi). Phys. Letters, 6: 248 (Sept. 15, 1963). (In English)

A low-temperature specific heat of bismuth exhibits a T^2 dependence on temperature T, suggesting a more or less layer structure for this metal. An appropriate model is used to explain this. Calculated and experimental results for C_v are shown. (R.E.U.)

41615 EFFECT OF CHANNELLING OF DISPLACEMENT CASCADE THEORY. P. Sigmund (Atomic Energy Commission Research Establishment Risø, Roskilde, Denmark). Phys. Letters, 6: 251-3(Sept. 15, 1963). (In English)

It was previously suggested that the large disagreement between radiation damage measurements in metals and defect cascade theory might be reduced by taking the channeling effect into account. Previous assumptions are given in regard to this. A test is proposed for the expression for the average number $\nu(E)$ of defects in a cascade of knock-on energy E. It is found that $\nu(E)$ is, contrary to ordinary cascade theory, strongly dependent on the cross section, and that the fluctuations of $\nu(E)$ are larger and ionization effects may not be neglected. (R.E.U.)

41616 SCINTILLATIONS IN NORMAL AND SUPERFLUID HELIUM. J. R. Kane, R. T. Siegel, and A. Suzuki (Carnegie Inst. of Tech., Pittsburgh). Phys. Letters, 6: 256-7(Sept. 15, 1963). (In English)

Measurements were made in a high-resolution counter on the temperature variation of the number of photons emitted by helium after charged particle traversal. The measurements show an abrupt change in pulse-height at the λ point, which indicates an effect from the superfluid component of the liquid. (R.E.U.)

41617 DETERMINATION OF ISOTOPIC DIFFERENCES IN MESIC X-RAYS IN CALCIUM. H. L. Anderson (Univ. of Chicago), C. S. Johnson, E. P. Hincks, S. Raboy, and C. C.

Trail. Phys. Letters, 6: 261-4(Sept. 15, 1963). (In English)

Measurements of the isotopic shift in the energies of the 2p–1s transitions in targets of Ca^{44} and Ca^{40} were made to obtain information about the distribution of charges in the nucleus. It was found that this transition in the μ-mesic atom of Ca^{44} is 4.8 ± 2.0 kev more energetic than the corresponding transition in the μ-mesic atom of Ca^{40}. (R.E.U.)

41618 EXCITATION SPECTRUM OF A MANY-BOSON SYSTEM. James D. Talman (Univ. of Western Ontario, London). Phys. Rev., 132: 955-8(Nov. 1, 1963).

It is shown within the framework of certain approximations that the excitation spectrum of a many-boson system satisfies the dispersion equation $E_q = |q|v$, where q is the momentum of the excitation and v is the macroscopic sound velocity. The approximations that are necessary are described. A method of avoiding the difficulties that arise in discussing a system with attractive forces is suggested, so that it may be possible to perform a calculation of the properties of liquid helium. (auth)

41619 ANALYTIC PROPERTIES OF THE PARTITION FUNCTION NEAR THE NORMAL-TO-SUPERCONDUCTING PHASE TRANSITION. R. Balian (CEN, Saclay, France) and J. S. Langer. Phys. Rev., 132: 958-60(Nov. 1, 1963).

It is shown that the grand partition function for a superconductor has analytic properties near the transition point in the complex temperature plane similar to those described by Lee and Yang in their statistical theory of condensation. The normal and superconducting regions of the complex plane are separated by a line of zeros that, in the limit of infinite volume, becomes a natural boundary. (auth)

41620 PARAMAGNETIC SUSCEPTIBILITY OF METALLIC LITHIUM AND SODIUM BY ELECTRON SPIN RESONANCE SATURATION. Richard Hecht (Columbia Univ., New York). Phys. Rev., 132: 966-72(Nov. 1, 1963).

The total conduction electron spin moment of lithium and sodium dispersions was measured in polarizing fields of about 10 G. The steady-state change in sample polarization at electron spin resonance was detected and then extrapolated to the limit of full saturation. Surprisingly, it was found that because the r-f fields were linearly polarized and comparable to the polarizing field, the saturation level did not increase monotonically with r-f field strength. The data were in good fit with saturation curves derived by means of numerical integration of the modified Bloch equation. The conduction electron spin susceptibility χ_s for lithium at 300°K was $(1.96 \pm 0.10) \times 10^{-6}$ cgs volume units. The relative values of χ_s in lithium were the same at 300, 77, and 1.5°K, within an estimated uncertainty of 3%, and the relative values of χ_s in sodium were the same at 77 and 1.5°K, within an estimated uncertainty of 5%. (auth)

41621 AUGER ELECTRON EJECTION FROM TUNGSTEN SURFACES BY LOW-ENERGY IONS. Franklin M. Propst and Edgar Luescher (Univ. of Illinois, Urbana). Phys. Rev., 132: 1037-46(Nov. 1, 1963).

Work on the study of the ejection of electrons from the surface of polycrystalline tungsten by He^+, H_2^+, N_2^+, and O_2^+ is reported. The total yields and energy distributions of the Auger electrons ejected by ions of 50-, 100-, and 200-ev kinetic energy are measured. The influence of adsorbed gases at the tungsten surface on the yields and energy distributions is also studied. (auth)

41622 ULTRASONIC DETERMINATION OF THE SUPERCONDUCTING ENERGY GAP IN VANADIUM. John L. Brewster, Moises Levy, and Isadore Rudnick (Univ. of California, Los Angeles). Phys. Rev., 132: 1062-72(Nov. 1, 1963).

Ultrasonic attenuation measurements on single-crystal cylinders axially oriented along the (110) crystallographic direction were used to determine the temperature-dependent superconducting energy gap $2\,\epsilon_0(T)$ of three samples of vanadium of different purities. An echo-pulse technique using longitudinal waves was used. The propagation direction was along the (110) for all the experiments. The zero-temperature energy gap for the three samples was found to be $(3.4 \pm 0.2)kT_c$, $(3.5 \pm 0.2)kT_c$, and $(3.5 \pm 0.1)kT_c$. These values were computed by averaging the results obtained from 200 or 300 experimental points. They are in agreement with the Bardeen, Cooper, and Schrieffer result that $2\,\epsilon_0(o)$ should be equal to $3.5\ kT_c$ for all superconductors. The dependence of the normalized energy gap on the reduced temperature of these samples is closely predicted by the BCS theory. These experiments were performed within the frequency range 100 to 450 Mc, and in all of them the product of the ultrasonic wave vector times the electron mean free path was smaller than one. The temperature dependence of the attenuation in the superconducting state showed small oscillations. It is found that the amplitude of these is a small effect for very pure samples. Moreover, evidence was collected to show that these oscillations are not an inherent property of the superconducting state in vanadium but are probably associated with acoustic modes of wave propagation. (auth)

41623 ULTRASONIC DETERMINATION OF THE SUPERCONDUCTING ENERGY GAP IN TANTALUM. Moises Levy and Isadore Rudnick (Univ. of California, Los Angeles). Phys. Rev., 132: 1073-80(Nov. 1, 1963).

Ultrasonic measurements were performed on two single crystals of tantalum axially oriented on (110). The temperature dependence of the attenuation coefficient of longitudinal waves propagating in this direction was used to compute the temperature dependence of the superconducting energy gap of tantalum. It was found to be closely predicted by the Bardeen-Cooper-Schrieffer theory. The zero-temperature energy gaps of the two were $(3.4 \pm 0.2)kT_c$ and $(3.5 \pm 0.2)kT_c$, respectively, which are compatible with BCS result, $2\,\epsilon_0(0) = 3.5\ kT_c$. In the frequency range of these experiments, 45 to 340 Mc ql was smaller than one. (auth)

41624 MAGNETIZATION AND ELECTRICAL RESISTIVITY OF GADOLINIUM SINGLE CRYSTALS. H. E. Nigh, S. Legvold, and F. H. Spedding (Ames Lab., Ames, Iowa). Phys. Rev., 132: 1092-7(Nov. 1, 1963). (IS-661)

The magnetic moment of single-crystal Gd was measured in fields from 0 to 18 kOe along the (0001), $(10\bar{1}0)$, and $(11\bar{2}0)$ directions at temperatures from 1.4 to 900°K. Small anisotropy was observed below the Curie temperature and the easy direction of magnetization was found to be a function of temperature. The absolute saturation magnetic moment was found to be 7.55 Bohr magnetons/atom. The saturation magnetization was observed to follow the $T^{\frac{3}{2}}$ law from 200 to 50°K with a deviation from this law observed below 50°K. A ferromagnetic Curie temperature of 293.2°K is reported. The effective Bohr magneton number in the paramagnetic region is 7.98 and the paramagnetic Curie temperature is 317°K. Electrical resistivity measurements were made from 4.2 to 380°K on the b-axis and c-axis crystals. For the b axis, the resistivity changes slope at 293.2°K. The c axis exhibits a small maximum at 292°K and a shallow minimum at 340°K. (auth)

41625 EXTENSION OF THE STATISTICAL MODEL OF THE ATOM. Victor A. Erma (Giannini Scientific Corp., Santa Ana, Calif.). Phys. Rev., 132: 1100-10(Nov. 1, 1963).

The statistical model of the atom is extended within the semiclassical framework to include the correlation energy

of the electron gas, obtained by an interpolation formula that reproduces the known high and low density limits exactly. The basic equations of the model are derived, and general theoretical results valid for all free atoms and ions are obtained. These include the determination of the electron density at the edge of the atom, a virial theorem for the atom, and a treatment of the Fermi-Amaldi correction. The equations of the model are solved in terms of a Thomas-Fermi-Dirac-like approximation, in terms of a semiconvergent expansion for the potential near the nucleus, and numerically on a computer for the atoms argon, chromium, krypton, xenon, and uranium. The solutions of the model are illustrated in detail for the case of argon, including a calculation of the energy terms of the argon atom. Finally, the application of the extended model is illustrated by a calculation of atomic polarizabilities and diamagnetic susceptibilities and the results are compared with experiment. (auth)

41626 LARGE-ANGLE INELASTIC SCATTERING OF 500-kev ELECTRONS. J. W. Motz and R. C. Placious (National Bureau of Standards, Washington, D. C.). Phys. Rev., 132: 1120-2(Nov. 1, 1963).

Experimental results are given for the energy spectra of electrons inelastically scattered at 100 deg, with 500-kev electrons incident on thin targets of gold and of aluminum. This large-angle inelastic scattering arises primarily from the two processes of bremsstrahlung and of atomic K-shell ionization with a small contribution from multiple-scattering effects. In the 300-kev energy region for the scattered electron, the sum of the theoretical cross sections evaluated with the Born calculations of Racah and of Weber, Deck, and Mullin for the respective two processes is approximately an order of magnitude smaller than the experimental values. This disagreement can be attributed to the breakdown in this energy region of both the high-energy approximation in the latter calculation and the Born approximation in both calculations. (auth)

41627 DISSIPATIVE POTENTIALS AND THE MOTION OF A CLASSICAL CHARGE. [PART] II. Boris Leaf (Kansas State Univ., Manhattan). Phys. Rev., 132: 1321-6 (Nov. 1, 1963).

Examples of the motion of a point charge were found to be consistent with the hypothesis of Abraham that the mass of an electron (or positron) is entirely electromagnetic. Further consequences of this hypothesis are developed. It is shown that the conservation laws of the electromagnetic field and Maxwell's equations require that the total Lorentz force (including the self-force) on the charge should vanish. This result can be expressed as a Lagrangian equation of motion. The canonical four momentum of the charge is the product of the magnitude of the charge by the four potential of the field at the position of the charge. When the dissipative form of the potential for an unconfined point charge is used, the integro-differential equation of motion is obtained for a particle with zero bare mass. A mechanical momentum and mass are defined; these are associated with the singular part of the Green's function for the D'Alembert equation. The rate of change of this mechanical momentum is equal to the sum of the external force, the radiation damping force (with the correct sign obtained by the use of the retarded fields), and the gradient at the position of the charge of its Coulombic self-potential energy. For a particle assumed to follow a continuous trajectory, the integrals in the integro-differential equation of motion are evaluated by a procedure in agreement with, but much simpler than, that of Dirac. The result is the unrenormalized equation of Dirac for a particle whose mass is the divergent Coulombic self-energy. The effective momentum and mass in this equation are reduced to half of the mechanical momentum and mass by the force term arising from the gradient of the Coulombic self-potential energy. (auth)

41628 GENERALIZED HARTREE-FOCK APPROXIMATION FOR THE CALCULATION OF COLLECTIVE STATES OF A FINITE MANY-PARTICLE SYSTEM. Arthur K. Kerman (Massachusetts Inst. of Tech., Cambridge) and Abraham Klein. Phys. Rev., 132: 1326-42(Nov. 1, 1963). (TID-18841)

A finite many-particle system can have collective states for which the off-diagonal matrix elements of certain one-particle operators are of the same order of magnitude as the diagonal elements. In such cases it is suggested that the random-phase approximation is in need of generalization. Examples are the uniform translational motion of any system and the rotational motion of deformed nuclei. The generalization is suggested after a review and critical analysis of the Hartree-Fock approximation. The model single-particle wave functions of the latter are replaced by wave functions in a space labeled both by the particle variables and by the quantum numbers of the collective motion. These generalized amplitudes are defined field-theoretically, and a self-consistent scheme for their calculation is obtained from the equations of motion. In addition to the self-consistent potential defined in the enlarged space, the energies of the excited states also turn out to be given by a natural self-consistency requirement. The new calculational scheme is first applied to a systematic restudy of the random-phase approximation where the self-consistency requirement on the energies was previously overlooked. As a first characteristic application the total mass of a system in uniform translation, and a reinterpretation of the Hartree-Fock average field are obtained. (auth)

41629 BOSE SYSTEM OF HARD SPHERES. L. Liu and K. W. Wong (Northwestern Univ., Evanston, Ill.). Phys. Rev., 132: 1349-53(Nov. 1, 1963).

A generalized pseudopotential for hard-sphere interaction is obtained, which is valid for all angular-momentum states. This pseudopotential is then used in the evaluation of both the ground-state energy and the excitation spectrum for a dilute Bose system of hard spheres. The calculated ground-state energy agrees with that obtained by others; the excitation spectrum obtained for liquid helium resembles the phonon-roton spectrum introduced by Landau. (auth)

41630 STUDY OF THE PERTURBATION SERIES FOR THE GROUND-STATE ENERGY OF A MANY-FERMION SYSTEM. George A. Baker, Jr., J. L. Gammel, and B. J. Hill (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 132: 1373-87(Nov. 1, 1963). (LADC-5848)

In order to investigate the validity of the Brueckner and the simple sum of the ladder diagrams approximations to the energy of an infinite system of fermions, all the terms in the perturbation expansion through the fourth order in the strength of the potential were calculated as a function of density. The calculations were performed for a repulsive, square-well, two-body potential spin-$\frac{1}{2}$ fermions. Rigorous upper and lower bounds from the coefficients for the value of the ladder approximation were constructed and it is found that the standard solution procedures give reasonably accurate results (within a few percent). It is found that the error in the solution as obtained in practice to the equations of the Brueckner approximation is large compared to the size of its departure from the ladder approximation. It is found for low-to-moderate densities

and for low-to-moderate potential strengths that the Brueckner approximation both as a sum of a certain class of diagrams and as computed in practice lies above the ladder approximation while the complete perturbation theory lies below it. This result arises from the neglect of the ring diagrams by the Brueckner approximation. (auth)

41631 BASIS OF THE FUNCTIONAL ASSUMPTION IN THE THEORY OF THE BOLTZMANN EQUATION. M. S. Green and R. A. Piccirelli (National Bureau of Standards, Washington, D. C.). Phys. Rev., 132: 1388-1410(Nov. 1, 1963).

The long-time behavior of the n-particle probability densities for a large, dilute system of point particles interacting with short-range repulsive forces is studied. The main result is an exact series for the n-particle density that consists of two parts. The first part is a time-independent functional of the singlet density that is expressed as a functional power series and that is a direct analog of the equilibrium density series. The second part is also a functional power series in the singlet density but the coefficients depend on time and on the initial correlations. The coefficients of both series are given explicitly in terms of operators that are determined by the dynamics of isolated groups of particles. It is demonstrated that these operators vanish for phase points corresponding to motions during which there are two or more groups of particles that either are statistically and dynamically independent or are such that each of them is dynamically connected to the rest by no more than one particle. It is argued that all the terms of the exact series are finite and that the terms of second part (the error) decrease with increasing time so that the first part is the asymptotic form proposed by Bogoliubov. The relevance of the results for the Boltzmann equation is indicated. A form of the Boltzmann collision integral that is valid in the steady state and to all orders of the density is described. (auth)

41632 SOME COMPUTATIONS ON A LAYER MODEL FOR SUPERCONDUCTIVITY OF THE SECOND KIND. H. Van Beelen and C. J. Gorter (Kamerlingh Onnes Laboratorium, Leiden). Physica, 29: 896-900(Aug. 1963).

The original layer model for superconductors of the second kind is amended in such a way that it can account satisfactorily for their properties. This indicates that the quantized vortices of Abrikosov's model may not be essential for the interpretation of the properties concerned. (auth)

41633 ZEEMAN EFFECT OF DOUBLY IONIZED HAFNIUM, Hf III. P. E. Noorman, H. L. Geurts, W. B. Simons, and Th. A. M. Van Kleef (Universiteit, Amsterdam). Physica, 29: 901-4(Aug. 1963).

The Zeeman effect in the Hf III-spectrum was investigated and the patterns obtained experimentally were compared with those computed theoretically for LS coupling and for intermediate coupling. The agreement is considerably better in the latter case. Herewith the identifications given previously were confirmed. (auth)

41634 ATOMIC PARAMETERS FOR FIVE TIMES IONIZED OXYGEN. Carlos M. Varsavsky (P.E.C. Research Associates, Inc., Boulder, Colo. and Univ. of Buenos Aires). Planetary Space Sci., 11: 1001-14(Sept. 1963).

Rocket investigations of the solar ultraviolet spectrum, as well as laboratory plasma experiments, have brought about interest in the properties of highly ionized atoms. A review is presented of different methods that can be used for the calculation of certain atomic parameters in highly ionized systems, with particular emphasis on their application to the ion O^{5+}. The parameters consideerd are: eigenvalues, eigenfunctions, transition probabilities, photoionization cross sections, and cross sections for excitation and ionization by electron impact. (auth)

41635 SPIN-CHANGE CROSS SECTIONS BETWEEN HYDROGEN ATOMS. F. J. Smith (Queen's Univ., Belfast). Planetary Space Sci., 11: 1126-8(Sept. 1963).

Quantal calculations are improved by adopting more accurate interaction potentials (Dalgarno-Lynn) and by using the J.W.K.B. phase shifts in the semiclassical approximation in an effort to obtain better agreement with experiment. Cross sections are evaluated for the J.W.K.B., the Massey-Smith, and the Purcell-Field approximations. (R.E.U.)

41636 SUPERCONDUCTIVITY. Annesta R. Gardner. Prod. Eng., 34: No. 15, 72-7(July 22, 1963).

A review of the phenomena of superconductivity and its present and future applications is presented. Consideration is given to transition (critical) temperature, critical magnetic field, and critical (quenching) current relative to the design of superconductive components. Also considered are the properties of hard and soft superconductors with emphasis on Nb–Zr alloys and Nb–Sn intermetallics. The effects of heat treatment and cold working are also discussed. (Rev. Metal Lit., Vol. 20, No. 10)

41637 ELECTRON-PHONON INTERACTION AND CYCLOTRON RESONANCE IN METALS. Sadao Nakajima and Mitsuo Watabe (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 30: 271(Aug. 1963).

The theory of electron-phonon interaction shifting of the cyclotron and thermal masses is extended to include a d-c magnetic field in Fröhlich's Hamiltonian, obtaining the h-f conductivity. Landau's theory of Fermi liquids was applied to see the effect of the Coulomb interaction of electrons. (R.E.U.)

41638 WANNIER EXCITONS IN SIMPLE VAN DER WAALS CRYSTALS. R. S. Knox (Univ. of Rochester, N. Y.). Radiation Res., 20: 77-82(Sept. 1963).

It is proposed that the Wannier model can be usefully applied to exciton states in the solid rare gases, and it is shown that all but the lowest (n = 1) states in solid Ar appear to be good Wannier states. For the lowest state, the model is inapplicable in detail but at least provides an alternative to the Frenkel model which, because of the large spatial extent of excited rare-gas orbitals, also appears to be inadequate. It is emphasized that the lowest exciton state is not to be regarded as totally unexplained; rather, it is only the fine details of the internal charge distribution of this state which remain to be elucidated. Physically this state may be regarded as a hole in the p^6 shell of the atom, to which is bound an electron in some totally symmetric state resembling a highly perturbed 4s electron orbital or a complicated linear combination of Ar^- 4s orbitals on nearby neighbors. It is remarkable that in all rare gases the energy of the lowest state so closely matches the corresponding atomic excitation energy (in solid Ar, where the difference is greatest, there is a blue shift of only 0.5 ev). Although there seems to be no specific need to do so at present, the Wannier model can be used in more complicated molecular crystals, and it is hoped that this note will serve to illustrate its properties and limitations. If electron and hole mobilities in certain organic semiconductors turn out to be sufficiently large that ordinary charge transport rather than hopping is taking place, there will exist the distinct possibility that bound Wannier states lie just below the band gap involved. (auth)

41639 THEORY OF THE INTERACTION OF LOCALIZED ELECTRONIC EXCITATIONS. William T. Simpson (Univ. of Washington, Seattle). Radiation Res., 20: 87-100(Sept. 1963).

The matrix element connecting electronic excitation on a molecule at r in interaction with electronic excitation on a molecule at the origin was calculated by using quantum electrodynamics and perturbation theory to the first nonvanishing order. For transition moments, m_z, parallel to the z-axis, the matrix element is found to be $m_z^2[(\partial^2/\partial x^2 + \partial^2/\partial y^2)]\ (e^{-ik_0 r}/r)$. This result agrees with one found previously by using a semiclassical argument; also, the result goes over into the well-known Coulombic interaction matrix element (dipole approximation) when $k_0 \to 0$. (auth)

41640 ELECTRIC PROPULSION. W. E. Moeckel (Lewis Research Center, Cleveland). Science, 142: 172-8(Oct. 11, 1963).

The development of electric-propulsion systems with sufficiently low specific weights and sufficiently long lifetimes for interplanetary missions is difficult, but success appears likely. The ultimate benefits, in terms of man's ability to travel greater distances through space in less time and with vehicles of less initial weight and size than those currently visualized, appear to warrant an effort at least as great as that now being made to develop such systems. (auth)

41641 EMISSION SPECTRA OF RAREFIED MOLECULAR GASES EXCITED BY A MIXED BEAM OF PROTONS AND HYDROGEN ATOMS. G. N. Polyakova, Ya. M. Fogel', and Yu-mei Ch'iu (Gor'kii State Univ., Khar'kov). Soviet Astron. AJ (English Transl.), 7: 267-75(Sept.-Oct. 1963).

Emission spectra were obtained of N_2, O_2, air, CO, CO_2, H_2, H_2O, NH_3, and CH_4, excited by the impact of particles of a beam consisting of protons and hydrogen atoms with energies of 38 kev. Conjectures are made concerning the character of the elementary processes responsible for the appearance of bands and lines in the spectra. The spectra obtained are compared with the spectrum of the terrestrial aurora and the emission spectrum of the night sky of Venus. (auth)

41642 CONTOUR OF THE MÖSSBAUER LINE TAKING INTO ACCOUNT LOCAL VIBRATIONS. V. V. Khizhnyakov. Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 20, 67-91 (1963). (In Russian)

The Mössbauer effect taking into account both crystalline and local vibrations was considered. The contour of the Mössbauer line was connected with the moments of the distribution of the line intensities without taking into account the natural width Γ of the excited level of the nuclei. The zero, the first, and the second central moments were calculated. The contour of the Mössbauer line in several specific cases was found. The results reveal the influence of the change in the state of the γ-radioactive nuclei on the lattice vibrations, and will hold true at arbitrary temperatures. (auth)

41643 ON THE THEORY OF QUASILINEAR VIBRONIC SPECTRA. K. K. Rebane and V. V. Khyzhnyakov. Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 20, 153-6 (1963). (In Russian)

Calculations and comparisons of effects of local oscillations of infinitely narrow oscillation zones or general δ-shaped peculiarities in $P(\omega)$ energy losses and maximum $P(\omega)$ zones with a given distribution showed that in harmonic approximation nondegenerate local oscillations and δ formations in $P(\omega)$ contribute equally to the quasilinear spectra. Considerations of $P(\omega)$ maximums result in widening of all quasilines with temperature. The first three moments for quasilines in the presence of one narrow oscillation zone (one narrow $P(\omega)$ maximum) were calculated in Condon and harmonics approximation and in electron transition approximation without mixed normal coordinates. (R.V.J.)

41644 ISSLEDOVANIYA PO FIZIKE VYSOKIKH ENERGII I ELEMENTARNYKH CHASTITS. (Investigation on High-Energy and Elementary Particle Physics). Zh. S. Takibaev, ed. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 1-159(1963). Alma-ata, USSR, Publishing House of the Academy of Sciences, 1963. 159p.

Fifteen articles are included on high energy and elementary particle physics. The articles deal with nuclear structure, high energy interactions, and instruments and devices used in nuclear physics. Separate abstracts have been prepared for twelve articles. (R.V.J.)

41645 INDUCTIVE MHD GENERATOR. G. D. Cormack (Institut für Plasmaphysik GmbH, Garching, Ger.). Z. Naturforsch., 18a: 885-9(Aug.-Sept. 1963).

The electrodynamic response of a particular inductive magnetohydrodynamic generator was calculated. Expressions for the output voltage and output power were derived. The results of experiments conducted with the generator mounted on an electromagnetic shock-tube agreed with the theoretical predictions. The measured output power was of the order of 10 watts lasting for a few microseconds. (auth)

41646 THE OSCILLATION MULTIPLICATION OF SECONDARY ELECTRONS (MULTIPACTING EFFECT) AS IGNITION CONDITIONS FOR HIGH-FREQUENCY DISCHARGES. F. Kossel and K. Krebs (Technische Universität, Berlin). Z. Physik, 175: 382-90(1963). (In German)

It is experimentally shown that the breakdown voltage of high-frequency discharges at very low pressures becomes identical with the initial voltage of secondary electron resonance mechanism ("multipacting"). This result is discussed by means of a formerly published theory of multipacting. Experimental results of other authors were also judged by comparing them with the predictions of this theory. (auth)

41647 ELASTIC AND INELASTIC SCATTERING OF ELECTRONS ON GASES. I. SCATTERING ON HELIUM. J. Geiger (Technische Universität, Berlin). Z. Physik, 175: 530-42(1963). (In German)

The theoretical differential cross section for elastic scattering and for excitation of optical transitions in helium by electron impact was refined in Born approximation by use of the two parameter Eckart eigenfunction for the ground state and for the excited states. The angular distributions of 25-kev electrons scattered elastically and inelastically by helium were measured in the angular range $2.3 \times 10^{-4} \leq \vartheta \leq 4 \times 10^{-2}$. The intensity distribution of the elastically scattered electrons is in accordance with the theoretical curve for $\vartheta > 7 \times 10^{-3}$ and is disturbed at smaller angles by the primary beam. Normalization of the experimental values to the theoretical elastic differential cross section led to agreement between the experimental differential cross section for the excitation of the $2\ ^1P$ and $3\ ^1P$ state and the scattering formulas given. There are small systematic deviations (<20%) for the $2\ ^1P$ differential section in the angular range $3 \times 10^{-3} < \vartheta < 1 \times 10^{-2}$ only. The oscillator strength of these two transitions was determined from the scattering measurements: $f_{21} = 0.312 \pm 0.04$ and $f_{31} = 0.0898 \pm 0.006$. (auth)

41648 EQUILIBRIUM DIAGRAM FOR THE LIQUID-CRYSTAL He^3-He^4 SYSTEM. N. G. Bereznyak, I. V.

Bogoyavlenskii, and B. N. Eselson (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 45: 486-95(Sept. 1963). (In Russian)

Curves of initiation of solidification of solutions of He^3 in He^4 are studied and information is obtained on the width of the liquid-crystal diagram in the 1.4 to 4.2°K temperature range. The diagram within this temperature range is found to comprise several atmospheres. Triple points corresponding to a polymorphic transition in the solid state as well as a transition from the α to γ-phase in solid He^4 are found on the solidification curves. Considerations regarding the nature of the liquid–crystal diagram for the He^3–He^4 system over a broad temperature region (0–20°K) are presented on basis of available experimental data and a thermodynamic analysis. A description is given of the apparatus used for carrying out thermal analysis of the helium isotope solutions that includes a transducer for pressure measurements within the calorimeter. (auth)

41649 IONIZATION OF GASES BY FAST ATOMS AND SINGLY CHARGED HELIUM IONS. E. S. Solovev, R. N. Ilin, V. A. Oparin, and N. V. Fedorenko (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 45: 496-502(Sept. 1963). (In Russian)

Ionization of helium, argon, hydrogen, and nitrogen gases by fast He atoms and He^+ ions with energies between 15 and 180 kev is studied. The ionization cross sections of the gases and the cross sections for formation of slow ions with various e/m ratios is measured. The relation between the magnitude of the various ionization cross sections and the position of the peaks on the cross section versus velocity curves is discussed. (auth)

41650 ON THE EFFECT OF EXTERNAL FIELDS ON ANGULAR CORRELATIONS DURING CONSECUTIVE ELECTROMAGNETIC TRANSITIONS. L. Zastavenko and M. Podgoretskii (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 706-8(Sept. 1963). (In Russian)

The level scheme of an atom (or nucleus) under the simultaneous action of an electric field (or of quadrupole splitting) and a magnetic field is considered. It is shown that if certain conditions are met, the angular correlations may strongly change even when small magnetic fields are turned on. (auth)

41651 ON THE BORN-OPPENHEIMER METHOD IN ATOMIC COLLISION THEORY. V. I. Ochkur (Leningrad State Univ.). Zh. Eksperim. i Teor. Fiz., 45: 734-41(Sept. 1963). (In Russian)

A simple formula is obtained that can be employed for calculating exchange scattering of electrons on atoms with an accuracy that the Born formula yields in problems in which exchange does not have to be taken into account. The excitation functions for the 2^3S- and 2^3P-helium levels are calculated. The results are compared with the experiments and with the exchange scattering calculation based on the classical mechanics approximation. (auth)

41652 ABSENCE OF SUPERCONDUCTIVITY IN METALS OF THE BISMUTH TYPE. A. A. Abrikosov (Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 746-9(Sept. 1963). (In Russian)

It is shown that superconductivity is not observed in metals of the bismuth type because of weakness of interaction between the electron excitations. (auth)

41653 IONIZATION OF POSITIVE IONS BY ELECTRONS. S. E. Kupriyanov and Z. Z. Latypov (Karpov Inst. of Physics and Chemistry, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 815-16(Sept. 1963). (In Russian)

Ionization of singly charged (Hg^+, Xe^+, Kr^+, Ar^+, and Ne^+) and doubly charged (Hg^{2+}, Xe^{2+}, Kr^{2+}) ions by electrons was investigated using the method of crossed electron and ion beams in a double mass spectrometer. A diagram is given of relative cross sections for various ionizations as a function of electron. For 150 kev electrons the relative effective cross sections σ_{max} were 1.0, 1.4, 1.8, 0.3, 0.1, 1.3, 1.5, and 0.4 for Hg^+, Xe^+, Kr^+, Ar^+, Ne^+, Hg^{2+}, Xe^{2+}, and Kr^{2+}, respectively. The order of error for the relative cross section magnitudes was ±30%. The results indicate that the effective cross sections for single ionization are not a function of the initial ion charge. (R.V.J.)

41654 MAXIMUM EFFICIENCY OF PLASMA CURRENT GENERATOR. G. V. Gordeev (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 33: 1031-42 (Sept. 1963). (In Russian)

The maximum efficiency of a magnetohydrodynamic generator was investigated for the condition in which the energy from the plasma flux to the outer circuit is uniformly distributed along a channel. Channel profiling for confirming the condition is described. The maximum efficiency with constant magnetic field was correlated with efficiencies for various field configurations and constant temperature. (tr-auth)

41655 DISTRIBUTION OF POTENTIAL IN THERMIONIC ENERGY TRANSFORMER. S. A. Maev. Zh. Tekhn. Fiz., 33: 1131-3(Sept. 1963). (In Russian)

A previous analysis of potential distribution (φ) as a monotonous function of x indicated that with an interelectrode distance (L) larger than the Debye radius (r) a region filled with quasineutral plasma, where $(d\varphi)/(dx) = (d^2\varphi)/(dx^2) = 0$, appeared at $0 < x < L$. The situation is analogous with non-monotonous potential variations. It was assumed that electrons and positive ions are emitted by a cathode and have a Maxwellian velocity distribution. (R.V.J.)

41656 ON SHOCK WAVE INTERACTIONS. R. A. Antonova, E. M. Barkhudarov, B. P. Zhvaniya, G. I. Rostomashvili, and N. L. Tsintsadze. Zh. Tekhn. Fiz., 33: 1137-8(Sept. 1963). (In Russian)

High-speed recordings of shock wave interactions in air and argon indicated a great similarity in shock-shock and shock-wall interactions. Equations developed for reflection and incidence rates in the two processes coincided. (R.V.J.)

41657 ATOMIC STRUCTURE CALCULATIONS. Frank Herman and Sherwood Skillman. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1963. 366p. $9.75.

One-electron wave functions are calculated for all normal neutral atoms in the periodic table from helium through lawrencium. The numerical methods and the computer programs used to obtain these wave functions are described, and the means for generating such wave functions for any free atom or ion are presented. The Hartree-Fock equations are the primary generating functions used in this compilation. (R.E.U.)

41658 ATOMES, MOLECULES, NOYAUX. (Atoms, Molecules, and Nuclei). Pierre Fleury and Jean-Paul Mathieu. Physique Generale et Experimentale. Paris, Editions Eyrolles, 1963. 346p.

As an introduction, a review is given of the results obtained in electricity and optics that bear on the interpretation of particle motion and wave energy transmission. The book is then divided into two sections —atomic and molec-

ular structure and transmutations and nuclear structure. The principles of wave mechanics are explained in order to obtain a satisfactory representation of the structure of atoms, molecules, liquids, and crystals by furnishing a coherent explanation of the quantum laws. The study of radiations and transformations of radioactive substances has led to the study of artificial transmutations, cosmic radiations, and particle accelerators. The constitution of the nucleus, the nuclear forces, and utilization of nuclear energy are then considered. (tr-auth)

41659 MODULATED PLASMA ELECTRON BEAMS. L. H. Stauffer (General Electric Co., Schenectady, N. Y.). 8p. (CONF-60-3)

From Wescon Institute of Electrical and Electronics Engineers [Conference], San Francisco, Aug. 1963.

Techniques have been developed for producing electron beams of two amperes or more, from a plasma within a hollow cathode. Electron beam energies of 20 kilovolts are readily obtained and power densities of the order of 10,000 kilowatts per square inch can be obtained with the aid of auxiliary electromagnetic focusing. An inert gas atmosphere of a few microns pressure is used to initiate and maintain the beam. Beam intensity increases with both gas pressure and cathode potential but may be controlled by varying the potential of an internal electrode. Under constant pressure and cathode potential the beam intensity may be varied over a wide range by adjusting the potential of the internal control electrode. The effects of cathode design on the volt-ampere characteristics of the beam and the design of control electrodes are described. Also, performance data in both helium and argon are given. A tentative theory of the origin of electrons and of beam formation is proposed. Applications to vacuum metallurgy and to electron beam welding are described and illustrated. (auth)

41660 THERMODYNAMIC PROPERTIES OF He^3 AND He^4 SOLUTIONS. II. TEMPERATURES ABOVE THE SUPERFLUID TRANSITION IN SOLUTION. R. Chandra (Univ. of Delhi) and V. S. Nanda. 18p. (CONF-78-16)

From American Physical Society 1963 Summer Meeting, Buffalo, June 1963.

The thermodynamics of He^3 and He^4 solutions is considered for temperatures and concentrations for which the solution does not show superfluidity. Calculations of the excess chemical potentials from the experimental vapor pressure data were carried out between 1 and 2°K previously. It is found that while the behavior of the He^3 component can be reasonably explained down to 1°K within the framework of the classical solution theories, no such agreement is obtainable for the He^4 component. The discrepancy is explained by extending some general thermodynamical considerations of Gorter regarding pure He^4 to the solution. (auth)

41661 A PRELIMINARY STUDY OF THE ORIFICE FLOW CHARACTERISTICS OF LN_2 AND LH_2 DISCHARGING INTO A VACUUM. James A. Brennan (National Bureau of Standards, Boulder, Colo.). Boulder, Colo., National Bureau of Standards, Cryogenic Data Center, 1963. Preprint Paper E-6, 29p, $1.75. (CONF-176-8)

From Cryogenic Engineering Conference, Boulder, Colo., Aug. 1963.

The storage and handling of liquid propellants on board vehicles in space presents many problems. Flow characteristics of the propellants through holes made in the tank walls by meteoroid puncture is one such problem and is the subject of this work. Overall discharge coefficients for small-diameter, thick-plate orifices were determined as a function of discharge pressure using liquid nitrogen and liquid hydrogen. Discharge pressures from 3 mm Hg to slightly above the triple point were investigated. Flow characteristics appear to be sensitive to discharge pressure and the condition of the liquid upstream of the orifice. The condition of the liquid was, of course, dependent on the heat transfer to the containing vessel. A marked difference in flow pattern was observed that depended on whether the liquid was nearly saturated or if two phase flow existed. If the liquid was nearly saturated and no gas phase passed through the orifice, the flow could be very nearly predicted by the adiabatic, incompressible flow equations. When gas phase was present upstream of the orifice it appeared that solid formation could take place in the orifice itself and thereby retard the flow. In addition to the orifice discharge coefficients, a general discussion of observed flow patterns is presented. (auth)

41662 ELECTRON-ION RECOMBINATION IN HIGH TEMPERATURE AIR. Jerome Eckerman and Robert G. Stern (Avco Corp., Wilmington, Mass.). New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63-445, 36p, $1.00. (CONF-240-2)

From American Institute of Aeronautics and Astronautics Conference on Physics of Entry Into Planetary Atmospheres, Cambridge, Mass., Aug. 1963.

Electron density measurements in the near wake of small hypervelocity spheres are analyzed. The experimental conditions considered are a pressure of 100 mm. and flight speeds from 12,000 to 19,000 ft/sec. It is shown that a hemisphere-cylinder flow model is employed to compute the wake temperatures and inviscid wake streamlines. The calculated temperatures are associated with the recombination rate constants determined from the data. This second order recombination rate falls within the bounds of $3(10^{-3})T^{-\frac{1}{2}}$ to $9(10^{-3})T^{-\frac{1}{2}}$ cm^3/electron sec. (auth)

41663 A PROBE FOR ELECTRICAL CONDUCTIVITY MEASUREMENTS IN IONIZED GASES. Lemmuel L. Hill, Theodore Marshall, and Benjamin J. Crapo (Naval Ordnance Lab., White Oak, Md.). 31p. (CONF-24-18; NOLTR 62-186)

From 4th Symposium [on] Engineering Aspects of Magnetohydrodynamics, Berkeley, Calif., Apr. 1963.

A probe technique for measuring the electrical conductivity in a small region of an ionized flow field is described. The technique involves observing the interaction between an ionized gas and a small perturbing rf magnetic field. The probes are basically small coils. Several probes were dynamically calibrated in a shock-tube. A few preliminary measurements were made in the wake of a 4-in. sphere, which was subjected to high-speed flight conditions. (auth)

41664 MAGNETOHYDRODYNAMIC POWER GENERATION FROM A SUPERSONIC ROCKET EXHAUST. Leroy J. Krzycki, Harold M. Larsen, and William M. Byrne, Jr. (Naval Ordnance Test Station, China Lake, Calif.). New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63-384, 15p, $1.00. (CONF-226-4)

From 5th Biennial Gas Dynamics Symposium, Evanston, Ill., Aug. 1963.

A theoretical and experimental feasibility investigation of an MHD electrical power generator using a supersonic rocket engine exhaust (Mach 2.3, 2160 m/sec) as the working fluid was conducted at the Naval Ordnance Test Station, China Lake, California. Theoretical calculations of thermal ionization and gas conductivity, using digital computer computation, indicated that a supersonic gas source had definite advantages over a subsonic one. Experimental fir-

ings of a liquid rocket-MHD power generator proved the feasibility of the concept and indicated areas of developmental difficulty. (auth)

41665 SEMI-CONDUCTING DEVICE FOR THE PRODUCTION OF ELECTRICAL ENERGY. (to Telefunken GmbH). French Patent 1,286,969. Jan. 29, 1962. Priority date Mar. 9, 1960, Germany.

A device designed for the production of electrical energy consists of a semiconductor, in which a beta-emitter, such as Ni^{63} or Pd^{107}, is incorporated in the p-n junction. (NPO)

Astrophysics, Cosmology, and Geophysics

41666 (D1-82-0245) WHISTLER DETERMINATION OF ELECTRON ENERGY AND DENSITY DISTRIBUTIONS IN THE MAGNETOSPHERE. H. B. Liemohn (Boeing Scientific Research Labs., Seattle) and F. L. Scarf (Space Technology Labs., Redondo Beach, Calif.). Mar. 1963. 73p.

Fifty-seven whistlers recorded at five stations between April 1958 and June 1962 were employed to test the validity of model magnetospheric electron distributions and two theories for the upper cutoff frequency of the whistler signal. Five electron density distributions [constant, $\exp(3R_e/R)$, $(R_e/R)^{+3}$, $(R_e/R)^{+3}\exp(3R_e/R)$, and $(R_e/R(0°))^{+3}\exp(-3R_e/R(0°)+3R_e/R)$] were tested, but only the ones with an $(R_e/R)^{+3}$ factor produce self-consistent results. In these cases, the ratios of f_U, the upper cutoff frequency, to f_c (0°), the equatorial gyrofrequency, are scattered with most whistlers having $f_U/f_c(0°) > 0.5$. This indicates that the cutoff is probably not caused by escape of high-frequency components from field-aligned ducts. On the other hand, the assumption that the cutoff above f_U is caused by a thermal Doppler shift in the cyclotron resonance is strongly supported. For these whistlers the resonant particle energies at f_U range between 0.2 and 2.0 kev and in this interval the differential energy spectrum of the normalized density, $N_0^{-1}dN(E)/dE$, is a remarkably smooth function which varies as E^{-1} with no significant height ($3 < R(0°)/R_e < 5$) or time variation. (auth)

41667 (NASA-TN-D-1901) THE PLASMA IN INTERPLANETARY SPACE. L. Biermann (Max-Planck-Institut für Physik and Astrophysik, Munich). Oct. 1963. 16p.

Interplanetary plasma, including the various lines of evidence for it, is described. An account is also given of the structure and composition of comets with emphasis on the ionized tails. The characteristics of these tails are explained by their interaction with a "solar wind" type plasma. Cometary phenomena bearing on the spatial and temporal distribution and dynamics of the plasma are discussed. A space experiment consisting of the formation of an artificial plasma cloud whereby these ideas could be tested and the plasma further investigated is described. Calculations indicate that the release of about 100 grams of barium at 200,000 km could be observed. (auth)

41668 (UAG-R-129) SOLAR ACTIVITY AND POLAR CAP ABSORPTION EVENTS. Scientific Report No. 2. Anne B. Kahle (Alaska. Univ., College. Geophysical Inst.). July 1962. Contract AF19(604)-5574. 83p. (AD-289533; AFCRL-62-708)

The known facts about visible characteristics of solar flares and flare associated solar radio emission, solar ultraviolet and x-rays, solar cosmic rays and polar cap absorption, and solar corpuscular streams are briefly reviewed. Tables of data of the occurrence of these phenomena in conjunction with polar cap absorption (PCA) events are given. It is shown that all large PCA events, which are caused by solar cosmic rays, are associated with large solar flares. The cosmic rays created by flares on the eastern part of the sun's disk are found to take up to 65 hours to reach the earth, while flares from the western part generally reach the earth in one or two hours. Type II and Type IV solar radio emissions apparently occur more frequently during the flares that create PCA than with all class 3 flares. Types I and III occur with almost every PCA event. All the flares that create PCA also cause strong sudden short wave fadeout, and often cause sudden cosmic noise absorption and sudden enhancement of atmospherics. It was found that the more intense the PCA event the shorter the time was between the flare and the onset of a sudden commencement magnetic storm. The more intense PCA also appeared to be associated with a more intense Forbush decrease. The theories of origin of the various types of solar emission are discussed, as are the theories of interplanetary magnetic fields and their plausibility from the standpoint of the observed PCA events. 68 references. (auth)

41669 NEWER WORKS ON THE VAN ALLEN RADIATION BELTS. R. Fiebig. Atomkernenergie, 8: 321-9 (Sept. 1963). (In German)

From available English and American publications results of investigations of the van Allen radiation belts are compiled and discussed. The following points of interest are considered: structure and composition, physical foundations, magnetic effects, and mechanisms of injection into and of loss of particles out of the radiation belts. (auth)

41670 THE DECAMETRIC RADIO EMISSIONS OF JUPITER. G. R. A. Ellis and P. M. McCulloch (Univ. of Tasmania, Hobart, Australia). Australian J. Phys., 16: 380-97(Sept. 1963).

The cyclotron theory of the decametric radiations of Jupiter is examined in detail. Providing Jupiter is surrounded by an extensive ionized exosphere, it is shown that the theory accounts for the observed variation in the number of radiation bursts with planetary rotation, their polarization, and their spectra. It is found also that the average power of the bursts and their polarization are functions of the number of bursts. The configuration of the Jupiter magnetic field is discussed. It is suggested that this deviates from that of a dipole with a maximum deviation in dip angle of 13° between longitudes 200 and 260° below a height of about 35,000 km. (auth)

41671 POLARIZATION MEASUREMENTS OF JUPITER RADIO BURSTS AT 10.1 Mc/s. R. L. Dowden (Univ. of Tasmania, Hobart, Australia). Australian J. Phys., 16: 398-410(Sept. 1963).

At 10.1 Mc Jupiter bursts of both senses of circular polarization are readily observed. The algebraic mean axial ratio is a strong function of Jovian longitude. This is almost entirely due to variation with longitude of the relative proportion of bursts of opposite sense of polarization. If bursts of the two senses (L.H. and R.H.) are analyzed separately the two mean axial ratios show little or no variation with longitude and are equal and opposite in sign. The axial ratio distribution and other observations are compared with the predictions of the Doppler-shifted cyclotron theory. (auth)

41672 MASSIVE STARS WITH UNIFORM COMPOSITION. R. Van der Borght and S. Meggitt (Australian National Univ., Canberra). Australian J. Phys., 16: 415-22(Sept. 1963).

A set of tables is derived, which greatly facilitate the

construction of models of massive stars with uniform composition. It is shown how these tables can be used. The method is applied to derive models of stars composed of pure hydrogen in which a small amount of C^{12} is present. (auth)

41673 OBSERVATIONS OF EARTH-CURRENT VARIATIONS ASSOCIATED WITH THE U.S. HIGH-ALTITUDE NUCLEAR EXPLOSION OF JULY 9, 1962. Peter Graystone (Defence Research Telecommunications Establishment, Ottawa). Can. J. Phys., 41: 1743-4(Oct. 1963).

The earth-current detection system consisted of two copper-coated steel rods, 2 meters long, driven into the ground 500 meters apart along an east-west path. The output from these rods, which was filtered, amplified, and recorded on two rectilinear recorders, is shown. (R.E.U.)

41674 1600-kev ELECTRONS IN EARTH'S RADIATION BELT. A. I. Ershkovich (Inst. of Atmospheric Physics, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Geofiz., No. 9, 1457-61(Sept. 1963). (In Russian)

Angular and energy distributions of 1600-kev electrons produced by fast neutron decay in the earth's radiation belt was analyzed. It is shown that the distribution function at the moment of electron production is not in azimuthal symmetry with the geomagnetic field. (R.V.J.)

41675 THERMIONIC SCREENING OF BODIES IN THE ATMOSPHERE AND INTERPLANETARY SPACE. C. S. Shen (Goddard Inst. for Space Studies, New York) and K. P. Chopra. J. Atmospheric Sci., 20: 359-65(Sept. 1963).

Problems are considered that accompany thermionic emission of electrons from a hot body surrounded by a plasma. In the absence of other mechanisms, an electric potential is established at the surface of the body through the balance of thermionic emission and accretion of electrons from the external plasma. Analytical solutions are obtained for the electric potential field and the electron density distribution around the body. A possible application of this analysis to objects in space is indicated. (auth)

41676 NATIONAL REPORT ON GEOMAGNETISM AND AERONOMY FROM JAPAN. Y. Kato, S. Akimoto, H. Uyeda, M. Huruhata, T. Oguti, Y. Sekido, and Y. Tamura (National Committee for Geodesy and Geophysics Science Council, Japan). J. Geomagnet. Geoelec., 15: 1-35(1963). (In English)

Analyses of the data obtained in the Antarctica during the IGC and later periods brought forth a number of fruitful results, i.e., finding of S_q^p, quantitative relation between auroral intensity and geomagnetic disturbance, and anomalously intense secular variation. The IGY data were analyzed, so that detailed morphology and theory were advanced for various phases of magnetic storm. It became possible to trace the geomagnetic field intensity in Japan to 2000 years ago by magnetic measurement of both lava flows and baked earths. Theoretical studies on the formation of the F layer and on the mechanism of ionospheric storm in the F2 region for middle latitude was carried out. As a result of the analysis of the IGY data various features of the ionosphere were derived, especially radio-wave absorption in the polar region associated with a solar flare was to be noted. Using 50-Mc waves from Okinawa and Philippines, irregularities and motions in the ionosphere were investigated. Electron densities and temperatures were successfully observed by a new resonance probe on board a rocket. Auroras observed at both domestic and Antarctic stations were studied. Even the Doppler shift of Hα line as observed at Syowa Station was analyzed. Series of airglow observations were performed at 7 stations in Japan, while airglow observations were made on M/S Soya, the expedition ship to the Antarctica. Studies were conducted in regard to the solar-terrestrial relation including interplanetary magnetic field, physical condition of the radiation belt, and interaction between the solar wind and the geomagnetic field. Continuous observations of cosmic rays were carried out at 4 stations. At Syowa Station meson(μ) intensity was measured, while neutron and meson intensities were observed on M/S Soya. Unusual increase in cosmic ray intensity served for advancing a theory on the propagation of solar cosmic rays in the interplanetary space. A close relation between cosmic ray intensity decrease and Type IV solar radio outburst was obtained. Lightning discharge and associated atmospherics were observed. Efforts were made to analyze the observational results. Observation and statistics of whistlers were made. A new observatory for whistler observation was set up at Moshiri, Hokkaido. Atmospheric electricity was observed at Kakioka, and Memambetsu. The results of the IGY and IGC radiosonde observations were analyzed. (auth)

41677 DETECTION OF SOLAR PARTICLE STREAMS BY HIGH-FREQUENCY RADIO WAVES. B. B. Lusignan (Stanford Univ., Calif.). J. Geophys. Res., 68: 5617-32 (Oct. 15, 1963).

Interactions between radio waves and charged particles change their character when the particles have high average velocities. The nature of such interactions were investigated assuming no collisions, no external magnetic field, and low particle densities. A stream of such particles makes the medium anisotropic. As a result the medium propagates two waves of unchanging polarization, one linearly polarized perpendicular to the particle stream and a second at right angles to the first. Such a medium can change the polarization ellipse of a propagating wave. The sun produces such streams radiating outward either in the form of a steady solar wind or in bursts associated with sun spots. Three experiments are suggested to detect the streams by measuring polarization of waves propagated through them. The least sensitive of the three, moon radar, would have measurable effects only during increased solar activity; the other two, transmission to a deep space probe and observation of polarized cosmic noise sources, show effects even during quiet solar conditions. These sensitivities are based on observations of the proton component of the solar wind. (auth)

41678 WHISTLER OBSERVATIONS IN CONNECTION WITH NUCLEAR EXPLOSIONS. Harold E. Dinger and William E. Garner (Naval Research Lab., Washington, D. C.). J. Geophys. Res., 68: 5641-8(Oct. 15, 1963).

During part of the Plumbbob series of nuclear explosions at the Nevada testing grounds in September 1957, whistlers were obtained that proved to be two-hop whistlers originating in electromagnetic pulses associated with the explosions. It is shown that the probability of a naturally-excited whistler (from lightning) occurring at the exactly correct times in each case is extremely small. The electromagnetic pulse from the explosion was recorded simultaneously on two whistler recorders. (auth)

41679 PLASMA INSTABILITY AS A MECHANISM FOR AURORAL BOMBARDMENT. Joseph W. Chamberlain (Kitt Peak National Observatory, Tucson, Ariz.). J. Geophys. Res., 68: 5667-74(Oct. 15, 1963).

Under conditions thought to be realized during auroral disturbances, the magnetosphere plasma is shown to be unstable to low-frequency transverse waves that propa-

gate perpendicular to the external field, B_0, and have an electric vector parallel to B_0. This instability is generated by positive ions that drift with the phase velocity of the wave. In a dipole field the predominant wave frequency will be the mean bounce frequency for electrons; the wavelength will be of the order of the mean radius of gyration of the positive ions. The mechanism, providing a means of dumping trapped particles out the ends of the flux tubes, suggests an unforced explanation of several heretofore puzzling features of auroras. Observational tests and desirable extensions to the theory are proposed. (auth)

41680 GEOMAGNETIC AND SOLAR DATA. J. Virginia Lincoln (National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 68: 5879-82(Oct. 15, 1963).

Data are presented for the principal geomagnetic storm sudden commencements for the period April–June 1963. Maximum activity and ranges of the storms are presented. Solar activity characteristics are given for June 1963. (C.E.S.)

41681 POLARIZATION OF SYNCHROTRON RADIATION AND THE QUASI-TRANSVERSE PROPAGATION REGION. Leo J. Blumle (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 68: 5886-8(Oct. 15, 1963).

The discrepancy between observation and theory of the polarization of synchrotron radiation from trapped electrons injected by the July 9, 1962, nuclear test is resolved by consideration of the depolarization that results when the propagation conditions are near the quasi-transverse region. It is concluded that the initial polarization cannot be uniquely determined from ground-based observations unless a much narrower beam antenna is used in conjunction with a detailed study of the mode polarizations and differential phase shift. (C.E.S.)

41682 AURORAL-ZONE OBSERVATIONS OF INFRASONIC PRESSURE WAVES RELATED TO IONOSPHERIC DISTURBANCES AND GEOMAGNETIC ACTIVITY. W. H. Campbell (National Bureau of Standards, Boulder, Colo.) and J. M. Young. J. Geophys. Res., 68: 5909-16(Nov. 1, 1963).

Observations showed that most of the 10- to 110-sec-period infrasonic pressure waves originated in auroral disturbances. Associated magnetic and cosmic noise absorption effects, together with determinations of the arrival direction of the pressure fluctuations, indicated an ionospheric source. A unique event, not of the auroral type, that appeared to give evidence that a large, primarily tropospheric pressure front could produce a disturbance in the ionosphere was also studied. Mechanisms for the two types of observations can be found in well-accepted, auroral-zone ionospheric processes. (auth)

41683 MOTIONS OF THE MAGNETOSPHERIC BOUNDARY AND SURFACE MAGNETIC ACTIVITY DURING THE FLIGHT OF EXPLORER 10. Joan Hirshberg (Lamont Geological Observatory, Palisades, N. Y.). J. Geophys. Res., 68: 5917-24(Nov. 1, 1963).

The minor surface magnetic activity during the flight of Explorer 10 consisted mainly of worldwide simultaneous events. In space Explorer 10 found periods of plasma alternating with plasma-free periods. A comparison of the surface data and the data from Explorer 10 was inside the broad tail of the magnetosphere. This tail could have had a generally cylindrical shape. (auth)

41684 A MECHANISM FOR THE PRODUCTION OF CERTAIN TYPES OF VERY-LOW-FREQUENCY EMISSIONS. Shirley F. Hansen (National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 68: 5925-35(Nov. 1, 1963).

It was shown that some types of v-l-f emissions (hooks, risers, and falling tones) may be the result of cyclotron emission by energetic electrons trapped in the earth's magnetic field. Observational evidence suggests that a relatively intense electromagnetic whistler-mode wave may be necessary to trigger each such emission. An interaction mechanism is proposed by which certain electrons may couple with a wave already propagating along the same line of force. A gyroresonance is established that organizes the electrons so that cyclotron radiation can be coherent. A change in phase relation occurs for those electrons that have a longitudinal velocity component such that the Doppler-shifted frequency of the whistler wave seen by the electron is equal or nearly equal to the electron gyrofrequency. This condition is met by electrons moving in a direction opposite to the whistler wave and is satisfied only over a certain fraction of the line of force. Observations also show instances of a sudden change in slope of the rising tail of a hook or other v-l-f emission at the crossing of the spectrums of the emission and a whistler. This change is interpreted as the effect of the encounter of a whistler with the electron stream that changes both energy and pitch angle of the emitting electrons. (auth)

41685 THE HELIUM CONTENTS OF METALLIC METEORITES. Carl August Bauer (Pennsylvania State Univ., University Park). J. Geophys. Res., 68: 6043-57 (Nov. 1, 1963).

The He^3 and He^4 concentrations were measured in 53 samples taken from 34 different metallic meteorites. Two meteorites were identified, Deep Springs and Clark County, that have considerably higher helium concentrations than any previously measured. The hexahedrites Edmonton and Braunau probably have the lowest He^3/He^4 ratio yet found, with the possible exception of selected samples from Washington County. The exposure ages relative to Grant were estimated for 25 of the meteorites. The estimates for the 3 oldest are: Deep Springs, 1550; Piñon, 1140; and Clark County, 1050 m.y. The lowest age found in this study was 40 m.y. for Monahans. The helium concentrations in the meteorites of low nickel content are lower than those in the medium octahedrites. The hexahedrites, as a class, have especially low helium concentrations and low ratios, but this study did reveal two hexahedrites, Iredell and Cedartown, that have higher helium concentrations and normal ratios. It is suggested that the anomalous helium concentrations of the hexahedrites are attributable to the presence of a small concentration of background helium that contains little, if any, He^3. (auth)

41686 THE DYNAMICS OF SPHERICAL STELLAR SYSTEMS. II. THEORETICAL MODELS. Richard W. Michie and Peter H. Bodenheimer (Univ. of California, Berkeley). Monthly Notices Roy. Astron. Soc., 126: 269-81(1963).

An extensive set of models for spherical stellar systems using a distribution function that for the inner regions is obtained from the Boltzmann equation with encounters is presented. It is assumed that in the early stages of the formation of clusters and elliptical galaxies, encounters and orbital mixing played an important role in determining the presently observed structure. Since this early time period the systems have not changed much, and can now be considered to be in or near dynamical equilibrium. These assumptions permit an extension of the initial distribution function to describe the whole system at later

times. Numerical integrations produced models with a wide variety of structure, which are in agreement with the simple density distributions of star clusters as well as the more complicated run of the density observed in some spherical galaxies. (auth)

41687 ON THE RELATION BETWEEN THE PRODUCTION OF ENERGY AND THE COMPOSITION OF MATTER IN A STEADY UNIVERSE. A. Braccesi (Istituto di Fisica A. Righi, Bologna). Nuovo Cimento (10), 29: 543-8(July 16, 1963).

It is shown how a relation between the rate of nucleosynthesis, as measured by the energy generation in the stars, and the cosmical abundance of composite nuclei holds for every stationary model of the universe. On the basis of the present experimental data, it seems rather improbable that this relation is satisfied in the actual universe. (auth)

41688 IONIZATION OF Fe XIV BY ELECTRON IMPACT. John L. Kulander and Constantinos B. Emmanuel (Univ. of Colorado, Boulder and High Altitude Observatory, Boulder, Colo.). Phys. Fluids, 6: 1656-7(Nov. 1963).

The collisional ionization cross section for coronal ions, such as Fe XIV, is calculated. It is based upon the quantum defect method and the Bethe approximation. A one-electron model with a central field potential is used. (R.E.U.)

41689 SOME GENERAL THEORY OF ELECTRON DENSITY IRREGULARITIES IN THE IONOSPHERIC E-REGION. K. D. Cole (Dept. of External Affairs, Melbourne). Planetary Space Sci., 11: 759-65(July 1963).

The effect of electromagnetic forces on E-region ionization is discussed from a general standpoint. It is found that in strong large-scale concentrations of E-region ionization there is a strong correlation with the horizontal component(H) of the geomagnetic field and also a correlation with negative deviations of H. Weak small-scale irregularities can be formed by small-scale perturbations in the neutral particle density and in the ionospheric current density. It is shown that the E-region ionization may be maintained at night by compression of ionization downwards from higher levels and that the strongest auroral electrojets may manifest the pinch effect. (auth)

41690 THE DISTRIBUTION OF INTERPLANETARY HYDROGEN. T. N. L. Patterson, F. S. Johnson, and W. B. Hanson (Southwest Center for Advanced Studies, Dallas). Planetary Space Sci., 11: 767-78(July 1963).

A calculation is presented of the distribution of the neutral hydrogen in interplanetary space. The presence there of atomic hydrogen is inferred from rocket-borne measurements by Morton and Purcell; their measurements showed that 15 per cent of the observed scattered Lyman-α radiation was at a wavelength removed by more than 0.04 Å from the line center. This component must be scattered by interplanetary hydrogen since telluric hydrogen cannot be expected to contribute significantly to so wide a profile. The work described here is an extension of a recent theory of Axford, Dessler, and Gottlieb on the termination of the solar wind. A shock front can be formed in the region where the momentum flux of solar protons just equals the pressure exerted by the galactic magnetic field. Beyond the shock front the solar protons' velocities become randomized but remain approximately equal to the solar wind velocity. These energetic protons in time undergo charge-exchange with the neutral galactic hydrogen creating an isotropic source of high energy neutral hydrogen atoms, some of which move in the general direction of the Sun. The distribution of neutral hydrogen around the Sun, resulting from this flux of neutral hydrogen atoms, is calculated taking account of their loss by photoionization and charge exchange on their path towards the Sun. The absolute concentration of hydrogen from this source is derived using the results of Morton and Purcell. Following this procedure it is found that when the solar wind velocity and concentration at 1 A.U. are respectively 400 km sec^{-1} and 5 cm^{-3}, the concentration of interplanetary neutral hydrogen in the vicinity of Earth is about 0.02 cm^{-3} with the shock front located at about 20 A.U. from the Sun. Brief consideration is given to the dynamics of the shock front transition region and a tentative estimate is made of the galactic magnetic field strength. A value of about 3γ is obtained. (auth)

41691 SIFTING OF IONS IN THE IONOSPHERE. K. D. Cole (Dept. of External Affairs, Melbourne). Planetary Space Sci., 11: 779-88(July 1963).

Electric fields applied in the ionosphere redistribute ions in a manner dependent on their mobility through the neutral particles, and their lifetime. There should be temporal and spatial variations in the relative proportions of ions related to geomagnetic disturbance, particularly in auroral regions. The effect, sought experimentally, may reveal some morphology of ionospheric electric fields, which at present is inferred from magnetic records and ionospheric electron density measurements. An application to granulation of ions in the solar chromosphere is suggested. (auth)

41692 GIANT PULSATIONS IN THE MAGNETIC FIELD AND PULSATING AURORA. S. Berger (Auroral Observatory, Tromso, Norway). Planetary Space Sci., 11: 867-8(July 1963).

Two cases are reported of simultaneously occurring Giant Pulsations in the magnetic field and pulsations in the zenith intensity of the auroral 5577 Å line. Data are taken from magnetic records at Tromsö, Norway, on November 10, 1961, and November 2, 1962. (R.E.U.)

41693 TRAPPED CHARGED PARTICLES AS THE ORIGIN OF SHORT PERIOD GEOMAGNETIC PULSATIONS. J. A. Jacobs and Tomiya Watanabe (Univ. of British Columbia, Vancouver, Can.). Planetary Space Sci., 11: 869-78(Aug. 1963).

A peculiar fan-shaped structure in the dynamic spectrum of short period geomagnetic pulsations with frequencies from fractions of a cps to several cps is interpreted theoretically. It is concluded that such geomagnetic pulsations are caused by hydromagnetic oscillations in the lower exospheric region excited by several bunches of charged particles, trapped in the Earth's magnetic field and moving with velocities of the order of several hundreds to a thousand kilometers per second. (auth)

41694 SPUTTERING RATES UNDER SOLAR-WIND BOMBARDMENT. G. K. Wehner, C. Kenknight, and D. L. Rosenberg (General Mills Electronics Group, Minneapolis). Planetary Space Sci., 11: 885-95(Aug. 1963).

With solar-wind data from Mariner II and laboratory sputtering yield measurements for H^+ and He^+ ion bombardment on metal, oxide, and stone targets, the sputtering rates for bodies in Earth orbit around the Sun are estimated to be 1.1 Å/year for Cu and 0.4 Å/year for Fe or stones. The Moon must have lost a layer roughly 17 cm thick in 4.5×10^9 years. Micrometeorites must have a very limited lifetime which is of the order of 25,000 years for a micron-size particle. (auth)

41695 GENERATION OF RADIO WAVES AND ACCELERATION OF PARTICLES BY THE CLASS 3 SOLAR FLARE OF 1961 SEPTEMBER 28. A. Maxwell (Harvard

Radio Astronomy Station, Fort Davis, Tex.). Planetary Space Sci., 11: 897-900(Aug. 1963).

The characteristics of the radio burst generated by the Class 3 solar flare of 1961 September 28, 2202 U.T. are described. The relation of the radio burst to accompanying x-ray and high-energy proton emission is then briefly examined in terms of existing theories of electromagnetic emission and particle acceleration in the solar atmosphere. (auth)

41696 PLANETARY CORONAE AND ATMOSPHERIC EVAPORATION. Joseph W. Chamberlain (Kitt Peak National Observatory, Tucson, Ariz.). Planetary Space Sci., 11: 901-60(Aug. 1963).

A comprehensive theory is presented for the region of a planetary atmosphere where collisions are rare and where the controlling factors are gravitational attraction and thermal energy conducted from below. The classic assumption of a sharply defined critical level above which the atmosphere is completely free of collisions is used initially. Throughout, the different types of particle orbits are treated separately; coronal particles are either ballistic (meaning captive particles whose orbits intersect the critical level), satellite (captive particles orbiting above the critical level), or escaping. Liouville's equation leads to exact expressions for the density distributions and escape flux. The latter is a simple analytic expression, but the density integrals are more complex and numerical evaluations are provided in tables. At large distances from the planet all the integrals may be evaluated in their asymptotic limits. Expressions are given for the different density components, the kinetic temperature, and heat flux. The latter two cannot generally be evaluated with the thermal conductivity as normally computed. The integrated density in a column above a specified height and orientated in a specified direction is given particular attention, because it fixes the critical level and because it is essentially an observable quantity. Numerical calculations are given for relating such observations in either the radial or transverse directions to the basic parameters of the corona (the critical-level density, temperature, and height above the planet). The radial integrated density at the critical level is shown to deviate sensibly from the simple expression applicable to a plane-parallel atmosphere unless the gravitational energy is very much greater than the mean thermal energy. Results of the preceding theory are utilized to justify the adoption of the concept of a critical level. The principal question focuses on the outward flux of escaping particles. A detailed treatment of escape as governed by collisions agrees with earlier similar analyses in showing that (with certain approximations) the critical-level concept predicts the accurate flux. However, it is noted that this result, except for confirming the height of the critical level, is trivial: it is a consequence of an assumed Maxwellian distribution and the special properties accruing to it. A variety of related problems dealing with production and loss mechanisms are discussed after some orbital properties and flight times are investigated. The critical-level theory cannot cope with the important question of the abundance of satellite orbits. Here it is shown that the satellite contribution may be included throughout the theory by omitting the expressions for the satellite component as such and evaluating the ballistic component, not with the critical level, but with a higher satellite critical level instead. For the Earth's hydrogen corona this level is near 2.5 Earth radii. The effect of photoionization on the density distribution of escaping orbits is also treated and shown to be negligible for the Earth. The concentration of hot interplanetary gas around a bare planet offers an interesting effect in that screening of orbits by the planet may more than counteract condensation due to the gravitational attraction. A hot, stationary interplanetary gas intermingled with a planetary corona will not have any appreciable effect on the coronal density or temperature distributions. Specifically, it is inappropriate to regard heat as being conducted (in the usual meaning of the word) from the interplanetary medium through the corona. Doppler profiles of coronal particles in a column along a specified direction were examined. Asymptotic expressions are given along with the general formulas, which will have to be evaluated numerically if and when the pertinent spectral observations are made. Even at large distances from the planet where the population consists largely of escaping particles, the shape of the spectral profile does not deviate very seriously in radially outward velocities from the profile with the Maxwellian distribution at the critical level. The basic assumption of the entire preceding theory that the establishment of a Maxwellian distribution near the critical level is examined. The collision treatment here is based on the Boltzmann equation, and while it is crude, it is not trivial. The conclusion is that the Maxwellian distribution in the upward direction is depleted beyond the escape velocity by several per cent, but this depletion is generally negligible when compared with errors produced by small uncertainties in temperature. The deviations would be important only were it possible to make measurements affected by the detailed shape of the velocity distribution curve. Real coronas are summarized briefly. While more and better observations are needed, it appears now that the hydrogen geocorona may become seriously perturbed into a geocoma, as Brandt labeled it, by solar particles flowing past the Earth. Attention is also directed to observations of the helium geocorona as a means of clarifying the now highly confused helium problem. Some estimates of the features of the Martian oxygen corona are made. Venus, as the Earth's sister planet, is an enigma, but coronal observations may point the way to an explanation of the distinctive differences between the evolution of the atmospheres of Venus and the Earth. (auth)

41697 DIURNAL VARIATION OF THE HYDROGEN CONCENTRATION IN THE EXOSPHERE. W. B. Hanson and T. N. L. Patterson (Southwest Center for Advanced Studies, Dallas). Planetary Space Sci., 11: 1035-52(Sept. 1963).

Three effects that must contribute to the diurnal variation of the abundance of atomic hydrogen in the exosphere of the earth are: (1) enhanced escape of hydrogen from the sunlit exosphere associated with the higher daytime temperatures; (2) lateral flow of hydrogen around the earth resulting from a departure of the hydrogen abundance from spherical symmetry; and flow of hydrogen into and out of the protonosphere by charge exchange with oxygen ions. Estimates are made of the importance of these effects. It is concluded that lateral flow of hydrogen is very efficient in preventing the formation of a large day-night asymmetry in the abundance of hydrogen. (auth)

41698 ON THE EXPLOSION OF TYPE II SUPERNOVA. Noboru Ohyama (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 30: 170-90(Aug. 1963).

Various nuclear reactions that take place after the collapse of a stellar core caused by Fe → He reaction at the iron core of aged massive stars are investigated, and it is shown that an enormous amount of energy from rapid nuclear reactions among light elements such as oxygen and

carbon gives rise to the generation of shock waves. The rate of energy generation and the total amount of energy released are calculated, assuming a burning front advancing outwards in the star, to be about 10^{47} erg/sec and 10^{51} to 10^{52} ergs, respectively. The behavior of propagation of the shock wave is calculated by the use of the method of Ôno et al. with a model of giant stars with mass of 15.6 M⊙. Escape of radiation from the shock front is also considered when the shock approaches the stellar surface. Then it is shown that the maximum luminosity is about 3×10^{43} erg/sec, the maximum temperature about 10^{5}K, the width of peak of light curve at the maximum luminosity 10^{5} to 10^{6} sec, and the expanding velocity of matter (0.5 to 1) $\times 10^{8}$ cm/sec. The fact that these values are fairly consistent with the observational data of Type II supernova appears to show that the massive stars may possibly become Type II supernovae at the last phase of giant stage. (auth)

41699 ČERENKOV RADIATION FROM THE NIGHT SKY, AND ITS APPLICATION TO γ-RAY ASTRONOMY. J. V. Jelley (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and N. A. Porter. Quart. J. Roy. Astron. Soc., 4: 275-93(Sept. 1963).

A study was made of processes that yield gamma rays in the energy region above the threshold of the Cherenkov technique (greater than 10^{12} ev) and which have a reasonable probability of occurrence. The two basic processes considered are the gamma rays from the decay of fast π^{0}-mesons in flight and gamma rays from the Coulomb-field bremsstrahlung of fast-moving electrons colliding with nuclei in gas clouds in interstellar space. The process of Cherenkov radiation is presented and its relation to light from the night sky. Various detection means are discussed. (R.E.U.)

41700 THE RADIATION BELTS, NATURAL AND ARTIFICIAL. C. E. McIlwain (Univ. of California, San Diego). Science, 142: 355-61(Oct. 18, 1963).

Data on the time- and space-dependence of trapped particles in three categories were obtained by detectors on the Explorer XV satellite. An unexpected secondary peak in the distribution of high-energy protons was found. The fluxes of high-energy protons slowly increased with time but apparently were not affected by geomagnetic events that caused perturbation of the electron fluxes on the same lines of force. About 1 or 2% of the electrons generated by the nuclear detonation of July 9, 1962 were found to be present in the geomagnetic field 125 days later. The electron fluxes in the region between L = 1.25 and 1.65 earth radii varied by less than 35% over the period from day 110 to day 206 after the detonation of 9 July. The spatial distributions of high- and low-energy electrons are quite different. Electrons in the region above L = 1.7 earth radii are strongly perturbed by magnetic disturbances. A new outer zone of both high- and low-energy electrons was formed by the magnetic storm which began December 18, 1962. (P.C.H.)

41701 ABSORPTION OF THE RADIATION FROM THE SOURCE SAGITTARIUS-A BY INTERSTELLAR NEUTRAL HYDROGEN. N. F. Ryzhkova, T. M. Egorova, I. V. Gosachinskii, and N. V. Bystrova (Main Astronomical Observatory, Academy of Sciences, USSR). Soviet Astron. AJ (English Transl.), 7: 12-16(July-Aug. 1963).

Observations of the continuous spectrum of the source Sgr A at 21 cm and a passband of 1.5 Mc were made. The width of the antenna pattern at the half-power level was 0.14° in the horizontal direction and about 5° in the vertical. The components of the source can be noted on the average transit curve. The absorption of the emission from Sgr A by neutral hydrogen in the vicinity of the sun and in the spiral arm at a distance of 3 kpsc from the galactic center is studied with a passband of 80 kc. All the components of the source are subject to an about equal attenuation by local hydrogen. The southwestern part of Drake's ring is apparently not subject to attenuation by hydrogen situated in the 3 kpsc spiral arm. (auth)

41702 A FACULA MODEL. M. A. Livshits (Shternberg Astronomical Inst., USSR). Soviet Astron. AJ (English Transl.), 7: 28-34(July-Aug. 1963).

Recent observations of the contrasts I_{fac}/I_{ph} of photospheric faculas in the continuum yield an improved facula model. The excess radiation flux in faculas ($\approx 10\%$ F⊙) arises from additional energy transfer due to increased convective motion in the active regions. (auth)

41703 THE NATURE OF P_I TYPE PEAKS. V. E. Chertoprud. Soviet Astron. AJ (English Transl.), 7: 35-43(July-Aug. 1963).

Type I bursts are correlated with P_I type bursts. The possible mechanism involved in the generation of peaks and radio bursts is considered and computed according to the scheme: stream of fast charged particles–plasma waves excited by the stream in the corona–transformation of plasma waves into electromagnetic waves–attenuation of electromagnetic waves in the corona. A qualitative estimate of the distributions of the number of P_I peaks (type I bursts) based on the proposed mechanism is made with respect to frequency of emission, intensity, position on the sun's disk, and other distributions. The results obtained are in close accord with all available data from observations of P_I type peaks and type I bursts. (auth)

41704 DETERMINATION OF SOME LARGE-SCALE MOTION PARAMETERS IN THE SOLAR PHOTOSPHERE. N. I. Kozhevnikov and M. A. Klyakotko (Shternberg State Astronomical Inst., USSR). Soviet Astron. AJ (English Transl.), 7: 44-50(July-Aug. 1963).

The analysis of the results obtained in elucidating the nature of the large-scale motions in the solar photosphere is given. It is found that the velocities $V(\varphi)$ may be represented, in the first approximation, in the form $V(\varphi) = K\varphi + \alpha \sin(2\pi\varphi)/(T)$. The variation of T is confirmed. The variability of K and α are studied in relation to the solar activity cycle. It is shown that K decreases toward the solar activity minimum and increases toward the solar activity maximum. The amplitude α increases toward the solar activity minimum. It is shown that the pattern of variation in the inclination of the zones lying toward the equator as a function of the phase of solar activity cannot account for these peculiar features. (auth)

41705 RADIO EMISSION FROM SOLAR ACTIVE REGIONS IN THE MILLIMETER REGION. A. G. Kislyakov and A. E. Salomonovich (Lebedev Inst. of Physics, Moscow and Gor'kii Univ., USSR). Soviet Astron. AJ (English Transl.), 7: 177-81(Sept.-Oct. 1963).

Results are given of observations of radio emission from solar localized sources, made simultaneously on 4 and 8 mm with a 22-m radio telescope. The dimensions and brightness temperatures of two sources, identified with spot groups, are determined. The data obtained are not in contradiction with the hypothesis that radio emission from active regions is thermal radiation emitted by coronal condensations that are optically thin in the millimeter region. Active regions identified with plages are also noted. (auth)

41706 THE ORIGIN OF HEAVIER-THAN-CALCIUM ELEMENTS. G. S. Malkiel' (Kurchatov Inst. of Atomic

Energy, Academy of Sciences, USSR). Soviet Astron. AJ (English Transl.), 7: 207-212(Sept.-Oct. 1963).

The way in which nuclei are synthesized by proton and neutron capture is discussed. In this process, nuclides of $Z > 20$ are created at the same place and at the same time, the bypassed nuclides partially transforming into nuclides on the neutron capture path, rather than vice versa. It is shown that the proposed hypothesis of synthesis of elements may be useful in explaining the laws governing the cosmic abundance of nuclides. The temperature at which the nuclides are synthesized is found to be 0.8×10^9 °K, and the neutron density is found to be 10^{16} n/cm^3. (auth)

41707 A RELATIVISTIC MODEL UNIVERSE. V. S. Brezhnev. Soviet Astron. AJ (English Transl.), 7: 215-17(Sept.-Oct. 1963).

A homogeneous isotropic model universe containing an ultrarelativistic gas is considered from the standpoint of relativistic cosmology. The particular case in which the model is free from physical singularities is examined, and the time dependence of the scale factor is investigated. A comparison is made with Friedmann's model, and the problem of reducing one to the other is formulated. (auth)

41708 SOME NEUTRINO PAIR PRODUCTION PROCESSES IN STARS. V. S. Pinaev. Zh. Eksperim. i Teor. Fiz., 45: 548-54(Sept. 1963). (In Russian)

Two processes of neutrino pair production in stars are examined: those occurring during recombination of ionized atoms and those due to β-interaction of electrons and positrons with nuclei. The reaction cross sections and neutrino energy losses are calculated. Energy emission from stars by neutrino pairs produced as a result of atom recombination is significant in white stars if the central temperature in them reaches 5–10 kev. β-interaction of electrons and positrons with nuclei (electron and positron capture of nuclei, β-decay) is accompanied by enormous losses of energy carried off by the neutrinos (up to $\sim 10^{18}$ erg/g·sec) at temperatures sufficient for electron-positron pair production. The process may be of interest for studying stars in their last stage of evolution and supernova flashes. (auth)

41709 SOME AVERAGE PROPERTIES OF THE OUTER RADIATION ZONE AT 1000 km. I. B. McDiarmid, J. R. Burrows, E. E. Budzinski, and Margaret D. Wilson (National Research Council, Ottawa). 28p. (CONF-250-4)

From American Physical Society 1963 Summer Meeting in the West, Edmonton, Can., Aug. 1963.

The particle detectors in the Alouette satellite were used to obtain time averaged intensity distributions for the particles in the outer radiation zone at an altitude of 1000 km. Average intensities of protons in the energy range 1 to 7 Mev and electrons with energies greater than 40 kev, 250 kev, and 3.9 Mev were obtained as a function of the invariant latitude, the particle pitch angle, and magnetic activity as determined by the Kp index. Some of the measurements are compared with ground based measurements of auroral radio absorption. (auth)

Cosmic Radiation

Refer also to abstract 40430.

41710 (AD-289433) [COSMIC RADIATION TO STUDY NUCLEAR INTERACTIONS]. Final Report, July 1, 1961–June 30, 1962. (Sydney. Univ. School of Physics). 6p.

Experimental research on nuclear interactions at 1 to 10^6 Bev involved exposure of nuclear emulsion to cosmic radiation at 115,000 ft for 7 hrs. The appearance of jets due to mesons produced in interactions with complex nuclei was noted. An array of 64 large plastic scintillators was put into operation to study extensive air showers that involve interactions at 10^5 to 10^8 Bev. An air shower theory under development predicts many aspects of the experimental air shower work. (D.C.W.)

41711 (AFCRL-63-881) OBSERVATIONS ON NIGHT-SKY CERENKOV RADIATION IN EXTENSIVE AIR SHOWERS. Final Report. H. Kasha (Israel Inst. of Tech., Haifa). May 15, 1963. Contract AF 61(052)-196. 62p.

The Cherenkov light associated with extensive air showers (EAS) between $\sim 2 \times 10^4$ and $\sim 2 \times 10^6$ was observed. The size spectrum of showers accompanied by Cherenkov pulses is much flatter than that of all showers, and the maximum pulse heights recorded for showers of a given size are almost independent of the particle number. This can be interpreted as a consequence of the zenith angle distribution of the EAS. The maximum intensity of the Cherenkov light was found not at the center but at some 20 m from it. This may be explained by the angular divergence of the shower particles. The results show that a shower theory must account for the lateral variation of the electron energy spectrum. (auth)

41712 (RM-3043-PR) GALACTIC COSMIC RADIATION AND MANNED SPACE FLIGHT. A. R. Tamplin and H. K. Fisher (RAND Corp., Santa Monica, Calif.). Dec. 1962. Contract AF49(638)-700. 28p. (AD-292077)

The flux and composition of primary cosmic particles of galactic origin are discussed together with the processes through which these particles may transfer energy to biological specimens. The biological effects of primary cosmic particles are estimated on the bases of both dosage and pseudo-target theory. The dosage was estimated according to the method of Tobias wherein it is assumed that all particles that enter the body are stopped within the body without undergoing nuclear collision and fragmentation. As such, this estimate is an upper limit for the dosage and corresponds to 0.07 rem/day. The pseudo-target-theory approach was based upon the consensus of radiobiologists that the only significant biological effect of primary cosmic particles will be injury to the neurons of the nervous system, since these neurons cannot be replaced. Using assumed values of kill cross sections and the measured flux of primary cosmic particles, it was possible to estimate that the fraction of neurons that might be killed as a function of exposure time is on the order of 1% in 100 days. (auth)

41713 (TID-19500) THE NATURE OF THE MOMENTUM SPECTRUM OF SECONDARY SHOWER PARTICLES FROM HIGH-ENERGY COLLISIONS. H. H. Aly, M. F. Kaplon, and M. L. Shen (Rochester, N. Y. Univ.). Aug. 29, 1963. Contract AT(30-1)-875. 29p.

The nature of the laboratory momentum spectra of the secondary shower particles from high energy nuclear interactions ($E_p \geq 14$ Bev), is investigated. By folding the well established distribution for the transverse momentum, p_t, of the secondary shower particles obtained at various primary energies with the differential space angular distributions of shower secondaries, an equation for the differential momentum spectra in the laboratory system is obtained. It is shown that a power law representation does not fit the whole range of the momentum spectra. The spectra obtained utilizing a constant value for the transverse momentum differ appreciably from the obtained relation for momenta less than 1 Bev/c. (auth)

41714 THE COSMIC-RAY NEUTRON LEAKAGE FLUX. R. E. Lingenfelter (Univ. of California, Los Angeles). J. Geophys. Res., 68: 5633-9(Oct. 15, 1963).

The intensity and spectrum of neutrons leaking out of the earth's atmosphere are calculated by a multigroup diffusion code as a function of latitude and solar cycle. The absolute intensity is obtained from normalization of the calculated flux to measured values in the atmosphere. The calculated neutron leakage intensity and spectrum are then compared with rocket and satellite measurements above the atmosphere. (auth)

41715 THE CHARGE RATIO OF COSMIC RAY MUONS AT LARGE ZENITH ANGLES. F. Ashton, K. MacKeown, P. V. Ramana Murthy, J. B. M. Pattison, and A. W. Wolfendale (Univ. of Durham, Eng.). Phys. Letters, 6: 259-60 (Sept. 15, 1963). (In English)

A horizontal magnetic spectrograph was used to measure the charge ratio of cosmic mesons(μ) as a function of energy. The charge ratio is the ratio of the numbers of positively and negatively charged mesons(μ) in the same energy interval. From these observations it is possible to examine some of the characteristics of nuclear interactions at primary energies $\geq 7 \times 10^{12}$ ev, which are unobtainable from present day accelerators. (R.E.U.)

41716 INTENSITY OF UPWARD MUON FLUX DUE TO COSMIC-RAY NEUTRINOS PRODUCED IN THE ATMOSPHERE. T. D. Lee (Columbia Univ., New York), H. Robinson, M. Schwartz, and R. Cool. Phys. Rev., 132: 1297-1300(Nov. 1, 1963). (NEVIS-115)

Calculations were performed to determine the upward going muon flux leaving the earth's surface after production by cosmic-ray neutrinos in the crust. Only neutrinos produced in the earth's atmosphere are considered. Rates of the order of one per 100 sq m/day might be expected if an intermediate boson exists and has a mass less than 2 Bev. (auth)

41717 POLARIZATION OF COSMIC-RAY μ MESONS. Hale V. Bradt and George W. Clark (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 132: 1306-16(Nov. 1, 1963). (TID-19437)

Measurements of the decay asymmetry of positive cosmic-ray muons that come to rest in a brass absorber at sea level under 12, 200, 700, and 3700 g/cm^2, air equivalent, of material and a determination of limits on the possible change with energy of the kaon-pion production ratio in nuclear interactions at energies from about 10 to about 100 Bev are reported. The measurements give values of the nominal polarization equal to 0.23 ± 0.03, 0.16 ± 0.02, 0.23 ± 0.03, and 0.21 ± 0.02 in order of increasing depth. The actual polarization is somewhat higher because of unevaluated systematic errors (e.g., electron scattering) that depend upon the details of construction of a given detector. The ratios of the polarizations observed at the different depths were compared with those computed under the assumption that the relative production rate of $K^+_{\mu 2}$ and π^+ mesons per unit energy interval varies with energy according to the relation $K(E)/\pi(E) \propto (0.3 + E)^{\delta}$, where E is the total energy measured in Bev and $\pi(E) \propto (0.3 + E)^{-2.64}$. It is found that the data can be fitted to this relation for any value of δ between $-\infty$ and +0.6. This result is rather insensitive to changes in the constants 0.3 and 2.64 and is based upon the assumptions that there is a negligible anomalous depolarization of the muons as they traverse the material above the detectors, and the muons arise only from the decays of pions and charged kaons. If charged and neutral kaons are produced in equal numbers, the upper limit for δ would be raised to about 1.3. (auth)

41718 THE RATE OF ENERGY LOSS OF HIGH-ENERGY COSMIC RAY MUONS. P. J. Hayman, N. S. Palmer, and A. W. Wolfendale (Univ. of Durham, Eng.). Proc. Roy. Soc. (London), Ser. A, 275: 391-410(Oct. 8, 1963).

The rate of energy loss of μ mesons is examined by comparing the observed depth-intensity relation with that predicted from a knowledge of the sea-level energy spectrum of cosmic-ray μ mesons. The evidence for each of the parameters entering into the analysis is assessed, and estimates are made of the sea-level μ meson spectrum up to 10,000 Bev and the depth-intensity relation down to 7000 m.w.e. The effect of range-straggling on the underground intensities is considered and shown to be important at depths below 1000 m.w.e. The energy loss relation is written as $-(dE/dx) = 1.88 + 0.077 \ln(E'_m/mc^2) + bE$ Mev g^{-1} cm^2, where E'_m is the maximum transferable energy in a $\mu - e$ collision and m is the μ meson mass. The first two terms give the contribution from ionization (and excitation) loss and the third term is the combined contribution from pair production, bremsstrahlung and nuclear interaction. The best estimate of the coefficient b is $b = (3.95 \pm 0.25) \times 10^{-6}$ g^{-1} cm^2 over the energy range 500 to 10,000 Bev, which is close to the theoretical value of 4.0×10^{-6} g^{-1} cm^2. It is concluded that there is no evidence for any marked anomaly in the energy-loss processes for μ mesons of energies up to 10,000 Bev. (auth)

41719 INVESTIGATIONS OF AZIMUTHAL ANGULAR DISTRIBUTION OF PARTICLES IN COSMIC SHOWERS. L. A. San'ko. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 64-70(1963). (In Russian)

Azimuthal effects in nucleon-nucleon interactions with two-humped angular spatial distribution, $\sigma/\sigma_{isotropic} \gg 1.5$, were studied, and comparisons were made of azimuthal properties of nucleon-nucleon and nucleon-nucleus showers with dispersions close to center-of-mass. It was found that the azimuthal anisotropy in two-humped angular distributions was larger than in one-humped. (R.V.J.)

41720 AZIMUTHAL DISTRIBUTION OF SHOWER PARTICLES PRODUCED BY COSMIC RAY PARTICLES IN PHOTOGRAPHIC EMULSIONS. Sh. Abduzhamilov, S. A. Azimov, L. P. Chernova, G. M. Chernov, and V. M. Chudakov (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Zh. Eksperim. i Teor. Fiz., 45: 407-14(Sept. 1963). (In Russian)

A new method for detecting various correlations in the azimuthal angular distribution of shower particles is proposed. The method is more efficient than that previously described. The effect of the momentum conservation law on the distribution of the random quantities introduced is investigated. Azimuthal isotropy and independence of emission angles for secondary particles are verified for 85 showers produced in photographic emulsions by singly charged cosmic ray particles with a mean energy ~25 Bev ($n_h + n_g \leq 5$, $n_s \geq 8$). It is shown that the main cause of violation of the aforementioned conditions is the law of conservation of momentum. Apparently there is no tendency to meson coplanarity. Finally, 117 interactions between singly charged cosmic ray particles and heavy emulsion nuclei were also investigated ($n_h + n_g \geq 8$, $n_s \geq 11$). An azimuthal asymmetry of secondary shower particles was observed for $n_h + n_g > 15$. (auth)

41721 ENERGY SPECTRUM OF NUCLEAR-ACTIVE PARTICLES IN EXTENSIVE ATMOSPHERIC SHOWERS.

Kh. P. Babayan, N. G. Boyadzhyan, N. L. Grigorov, E. A. Mamidzhanyan, Ch. A. Tretyakova, and V. Ya. Shestoperov (Moscow State Univ. and Inst. of Physics, Academy of Sciences, Armenian SSR). Zh. Eksperim. i Teor. Fiz., 45: 418-27(Sept. 1963). (In Russian)

Ionization bursts produced by nuclear-active particles in extensive air showers were studied with an arrangement of 192 ionization chambers with a total area of 10 m^2. Due to simultaneous incidence of several nuclear-active particles on the large area arrangement, the ionization burst spectrum differs from the spectrum of nuclear-active particles. The power exponent of the integral spectrum of bursts produced over an area of 10 m^2 in showers with more than 10^5 particles is $\gamma \sim 1.0$ (for bursts containing more than 500 relativistic particles) whereas the spectrum exponent for bursts produced by single particles in the same showers is $\gamma = 1.6 \pm 0.1$. (auth)

41722 FLUCTUATION OF NUMBER OF PARTICLES IN ELECTRON-PHOTON SHOWERS PRODUCED BY HIGH ENERGY μ-MESONS. E. V. Gedalin and N. M. Gerasimova (Inst. of Physics, Academy of Sciences, Georgian SSR and Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 45: 565-75(Sept. 1963). (In Russian)

Simple expressions are obtained for the mean square of the number of particles in electron-photon showers produced by high energy μ-mesons. Fluctuations can be studied by means of these formulas. (auth)

Criticality Studies

41723 (CEA-2274) ALECTO, EXPERIENCE DE CRITICALITE SUR UNE SOLUTION DE PLUTONIUM. RESULTATS EXPERIMENTAUX, CUVE No. 1 (ϕ = 324 mm). ALECTO—Criticality Experiment on a Plutonium Solution. Experimental Results. Vessel Number 1 (ϕ = 324 mm). J. Bruna, J. P. Brunet, R. Caizergues, C. Clouet D'Orval, J. Kremser, J. Leclerc, and P. Verriere (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 38p.

ALECTO is a critical experiment intended for the neutronic study of homogeneous aqueous multiplying media. It essentially consists of a cylindrical tank, reflected or not, where can be made critical a solution of fissionable material fed into the tank from a geometrically subcritical storage. The studies effected on this assembly concern on one hand the determination of critical masses, and on the other hand the nuclear parameters used in neutron calculations. The container tested in the first series of experiments described is a cylindrical tank, 324 mm diameter with a convex bottom, water reflected on the sides and on the interior. The minimum critical mass of this tank was determined and was found to be $M_{c\,min} = 845 \pm 7$ g. The decay constant of prompt neutrons as a function of reactivity was determined by the pulsed neutron technique. At the critical state, it was found to be $\alpha_c = 73 \pm 6$ sec^{-1}. Furthermore, from the study of this tank, were derived a number of safety regulations for plutonium solutions. (auth)

41724 (HW-77089) THE LIMITING CRITICAL CONCENTRATIONS FOR Pu^{239} AND U^{235} IN AQUEOUS SOLUTIONS. R. H. Masterson, J. D. White, and T. J. Powell (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 27, 1963. Contract AT(45-1)-1350. 30p.

Measurements were made with plutonium nitrate solutions and uranyl fluoride solutions (93.15% enriched UO_2F_2) to determine the concentration at which k_∞ equals unity (the limiting critical concentration) for each of these solutions. The limiting critical concentration for Pu^{239} in an aqueous solution occurred at an H : Pu ratio of 3392 ± 100; this limiting ratio corresponded to a concentration of 8.0 ± 0.3 g Pu^{239}/liter for the solutions used in the experiments. In conjunction with this plutonium measurement, the limiting critical concentration for U^{235} in an aqueous solution was measured; the result (12.05 ± 0.03 g U^{235}/liter) was compared to a similar result reported by the Oak Ridge National Laboratory. (auth)

41725 (HW-77871) PHYSICS RESEARCH QUARTERLY REPORT, APRIL-JUNE 1963. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 15, 1963. Contract AT(45-1)-1350. 69p.

Separate abstracts were prepared for the seven papers on critical mass and reactor physics. (D.C.W.)

41726 (HW-77871(p.4-11)) FLEXIBLE, HIGH ACCURACY TREATMENT OF INTERACTING FISSILE CYLINDER SYSTEMS. F. R. Czerniejewski (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The basic physical and mathematical analysis that led to the development of the 7090 computer code INTERSET that gives high accuracy in fissile vessel interaction calculations is described. Features of INTERSET, a sample problem, and INTERSET output are given. (auth)

41727 (HW-77871(p.12-18)) LATTICE PARAMETER CORRELATION FOR A CONCENTRIC TUBE-IN-TUBE FUEL ELEMENT. C. R. Richey and L. L. Carter (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The fast fission factors, resonance escape probabilities, eta's, and thermal utilizations measured by Wood for a concentric tube-in-tube fuel assembly in a graphite lattice with both air and water in the coolant annuli were calculated. The calculational procedures are discussed, and the calculated and measured values are compared. (D.C.W.)

41728 (HW-77871(p.19-21)) A DESCRIPTION OF THE HIGH TEMPERATURE LATTICE TEST REACTOR. W. W. Brown and R. E. Heineman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A High Temperature Lattice Test Reactor (HTLTR) now under design by Hanford Laboratories is described. A central experimental core region may be removed and any solid-moderated reactor lattice may be inserted for testing. Reactivity transients of the test lattices associated with changes in temperature of either moderator or fuel can be obtained in support of design and hazards analyses of proposed power reactors. (auth)

41729 (HW-77871(p.22-36)) EXPERIMENTAL STUDIES IN HIGH EXPOSURE Pu-Al LATTICES. T. B. Thornbury and L. C. Davenport (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Measurements were performed in the PCTR on graphite-moderated, air-cooled lattices fueled with clusters of nineteen 0.5-inch-diameter rods of Pu^{240}-enriched Pu-Al. The cells were arranged on a square pitch with lattice spacings of 6.5, 8.375, and 10.5 inches. For each lattice spacing, the mass of copper required to poison the central cell to a multiplication of unity was determined. Foil activation data were obtained at various positions throughout the lattices with gold, copper, U^{235}-Al, and Pu-Al detectors both bare and cadmium covered. The reactivity coefficients of copper, U^{235}-Al, and Pu-Al were measured in the fuel in the central cell. Relative activation rates, activation rates for a detector with a cross section varying inversely with velocity, cadmium ratios, and ratios of effective cross sections were calculated. (auth)

41730 (HW-77871(p.37-45)) DIFFUSION THEORY AND PERTURBATION CALCULATIONS FOR REACTIVITY MEASUREMENTS IN THE PRCF. B. Arcipiani and L. C. Schmid (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Calculations performed to determine the best arrangement (fuel and moderator) of the PRCF center cell for reactivity measurements on highly irradiated fuel samples are described. The arrangements considered, parameters used, and the results are given. (D.C.W.)

41731 (HW-77871(p.46-53)) SUBCRITICAL EXPERIMENTS WITH PuO_2–POLYSTYRENE COMPACTS. C. R. Richey, J. D.White, and E. D. Clayton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Criticality measurements on concentrated Pu solutions were simulated using PuO_2–polystyrene cubes with a H-to-Pu ratio of 15. Neutron multiplication measurements performed by arranging configurations of the cubes on halves of a split table that were then moved together gave the critical masses of the nonreflected and Lucite-reflected assemblies. An evaluation of control and safety rods, both poison insertion and fuel removal, showed the desirability of fuel removal type rods. The neutron spectrum for the PuO_2–polystyrene compacts was strongly epithermal. (D.C.W.)

41732 (HW-77871(p.58-61)) DETERMINATION OF THE RELATIVE WORTH OF PLUTONIUM ATOMS OF U^{235} ATOMS IN HOMOGENEOUS UO_3–WATER MIXTURES. L. L. Carter (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Multigroup calculations were made of the minimum U^{235} enrichment required for criticality in a UO_3–H_2O mixture at optimum moderation conditions. The quantity of Pu required to give a k_∞ of unity in a natural UO_3–H_2O mixture was then calculated for Pu^{239} and for Pu containing 5% Pu^{240}. Monte Carlo calculations gave the limiting U enrichment for criticality and the limiting critical Pu/U ratio. The results show that UO_3–H_2O mixtures with a Pu/U atomic ratio $<0.00155 \pm 0.00012$ should have a $k_\infty < 1$ when no Pu^{240} is present. When 5% Pu^{240} is present, the total $Pu(Pu^{239} + Pu^{240})$/total $U(U^{235} + U^{238})$ atomic ratio increases to 0.00190. The relative worth of Pu atoms to U^{235} atoms from a reactivity standpoint is 1.90 ± 0.14 and 1.54, respectively. (D.C.W.)

41733 (K-1582) A NUCLEARLY SAFE 12-1/4-in. I.D. PACKED LIQUID ENTRAINMENT SEPARATOR. H. F. Henry and C. E. Newlon (Oak Ridge Gaseous Diffusion Plant, Tenn.). Oct. 17, 1963. Contract W-7405-eng-26. 13p.

Commercially available borosilicate glass Raschig rings containing about 4 wt % boron were incorporated for nuclear safety in the design of a 12¼-in. ID packed liquid entrainment separator for processing uranyl nitrate solutions up to 93.2% U^{235} enrichment. The nuclear safety evaluation of this equipment as described was made originally in 1960. (auth)

41734 (WAPD-T-1483(Rev.)) THE REACTIVITY EFFECT OF WATER GAP SPACING AND U^{238} ON THE SYSTEM ZIRCONIUM–WATER–URANIUM-235. G. P. Rutledge, C. M. Condit, and F. A. Dobbe (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Oct. 18, 1962. Contract AT-11-1-GEN-14. 22p. (CONF-242-1)

From American Institute of Chemical Engineers Symposium, Chicago, Ill., Dec. 1962.

The reactivity of single homogeneous systems of zirconium–water–uranium-235 has been previously developed quantitatively. This information is extended by assessing the reactivity effect that results when homogeneous regions are separated by water gaps, i.e., heterogeneous systems. Several fuel regions which are stored adjacent to each other under water do not necessarily represent a maximum reactivity. As these regions are separated by a water gap, which is often necessary in the storage of fuel, a maximum peak reactivity is reached at a certain spacing between the regions. It is necessary that this maximum value always be determined before the fuel is handled unless it is mechanically impossible to vary this water gap. (auth)

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Refer also to abstract 40433.

41735 (AERI-P/R-7) STUDY OF MESON PRODUCTION IN THE PROTON-NUCLEON COLLISIONS AT ENERGY OF 28 Gev WITH NUCLEAR EMULSION. Lee Yung Jae (Atomic Energy Research Inst., Seoul). May 1963. 28p.

The characteristics of pions produced in P-N interactions at 28 Bev were studied. 54 clean white stars out of 817 stars that were found in along-the-track scanning of 308m were selected to be analyzed. By blob counting and multiple scattering measurement 54 tracks out of 127 measurable tracks were identified as pions. The multiplicity of shower tracks was 4.69 ± 0.34. The average transverse momentum and energy of pions in the laboratory system have been found 0.24 ± 0.02 Bev/c and 2.09 ± 0.23 Bev. No correlation between the transverse momentum and angle of emission in the center-of-mass system was found. Inelasticity in the center-of-mass was found to be 0.42. A two-maximum shape of distribution of shower tracks in coordinate $\log \gamma_c \tan \theta_L$ was observed as predicted by multi-fire-ball model for 6 stars with dispersions >0.6. The value of γ_c was estimated to be 4.1 from the distribution in coordinate $X = \log \tan \theta_L$, in good agreement with the calculated value. The velocity of the fire-ball was also calculated from the values of γ_f, γ_b and was found to be 1.79, which agreed with the predicted value of 1.5 by the multi-fire-ball model. (auth)

41736 (BNL-7294) INTERACTIONS OF HIGH-ENERGY ANTIPROTONS IN HYDROGEN. C. Baltay (Yale Univ., New Haven); B. B. Culwick (Brookhaven National Lab., Upton, N. Y.); A. H. Bachman, et al. (City Coll., New York). [1963]. Contract [AT(30-2)-Gen-16]. 42p. (CONF-122-12)

From International Conference on Nucleon Structure, Stanford, Calif., June 1963.

Results of an investigation of $\bar{p}$-ρ interactions at 3.25 and 3.69 Bev/c are presented and compared with theoretical predictions and, in some instances, with results on ρ-ρ interactions. Elastic scattering, meson(π) production, annihilation into mesons(π) and mesons(K), and antihyperon production in these interactions were examined. (D.C.W.)

41737 (CONF-46-102) PRODUCTION OF STRANGE PARTICLES BY π^+–p COLLISIONS AT 2.08 Gev/c. Horst W. J. Foelsche and Henry L. Kraybill (Yale Univ., New Haven). [1963]. Contract [AT(30-1)-1349]. 21p.

From American Physical Society 1963 Spring Meeting, Washington, D. C., Apr. 1963.

The total cross section (0.72 mb) obtained for the interaction is much higher than that previously observed at 1.39 Bev/c, but Σ^+–K^+ production is weaker. Cross sec-

tions for the interactions producing strange particles are listed. The Σ^+ angular distribution shows a strong backward tendency for the hyperon. The effective mass distributions for $\pi^+ - p \rightarrow \Lambda^0 + K^+ + \pi^0$ indicate a Λ-π resonance (Y^*) with a mass and width of 1382 ± 4 Mev and 28 Mev. The Y^* decay seems to be independent of the production, and the angular distributions of Y^* decay and production support a spin assignment $> 1/2$. In the $\Sigma^+ + K + \pi^0$ and $\Sigma^+ + K^0 + \pi^+$ final states, only the 885-Mev K^* could be definitely verified. (D.C.W.)

41738 (CTSL-40) THE REACTION $\gamma + N \rightarrow \pi + N$ AT HIGH ENERGIES. George Zweig (California Inst. of Tech., Pasadena. Synchrotron Lab.). Aug. 26, 1963. Contract AT(11-1)-68. 58p.

The interaction $\gamma + N \rightarrow \pi + N$ is studied at high energies in both the forward and backward directions using the helicity formalism. Contributions from ρ, ω, ϕ, and π trajectories in the t channel and from the $N^*_{1/2+}$ $N^*_{1/2+}$ and $N^*_{1/2-}$ trajectories in s channel are included. Polarization formulas for the final state nucleon are given. If cuts in the angular momentum plane are neglected, then at high energies for momentum transfers $-t \gg \mu_\pi^2$ the ρ trajectory should dominate charged pion photoproduction in the forward direction. A crude estimate of the cross section yields $(d\sigma/dt) \sim s^{2j_\rho(0)-2} \approx (1/s)$. However, the pion trajectory is expected to be important for small momentum transfers up to very high energies. Inclusion of both the ρ and π trajectories yields the interesting result that π^+ and π^- photoproduction cross sections are identical at high energies in the forward direction. For forward π^0 photoproduction both the ρ and ω trajectories should be important. The cross section is estimated to be $(d\sigma/dt) \sim (1/s)$. If one trajectory is dominant, then the differential cross sections for $\gamma + \bar{p} \rightarrow \pi^0 + p$ and $\gamma + n \rightarrow \pi^0 + n$ should be identical. For photoproduction in the backward direction, the situation is much more complex with at least three trajectories contributing to $(d\sigma/ds)$. However, since the same set of trajectories are to be used in πN scattering, backward πN scattering and backward photoproduction are expected to have the same energy dependence. Assuming that the $N^*_{1/2+}$ trajectory dominates with $j_{N^*_{1/2+}}(0) \approx 0$, $(d\sigma/ds) \sim s^{2j_{N^*_{1/2+}}(0)-2} \approx (1/s^2)$ is obtained. (auth)

41739 (DESY-A-2,103) ABSCHATZUNG DER MEHRFACHERZEUGUNG BEI EXPERIMENTEN ZUR PHOTO-EINFACH-ERZEUGUNG. (Estimation of Multiple Production by Experiments on Single Photo Production). J. von Behr and G. Ripken (Deutsches Elektronen-Synchrotron, Hamburg). Aug. 1963. 37p.

The double photoproduction of pions will increase the counting rate of protons from single photoproduction at several Bev. This increase (as a function of the peak energy of the bremsspectrum) is discussed on the basis of the available phase-space in the laboratory system. The 3-3-isobar is considered as a further channel for double production. The method is compared with experiments between 0.5 and 1 Bev. (auth)

41740 (LAMS-2960) IMPLICIT RADIATION DIFFUSION. Robert N. Thorn and Burton Wendroff (Los Alamos Scientific Lab., N. Mex.). Aug. 15, 1963. Contract W-7405-eng-36. 26p.

It is shown that a considerable saving in computing time can be obtained by the use of unconditionally stable, or implicit, finite difference approximations to the radiation diffusion equation. The effectiveness of implicit difference equations depends on the existence of rapidly covergent iteration procedures for solving the nonlinear system of equations that determines the temperature distribution at each time step. By application to some typical situations Newton's method is shown to provide such a procedure. For treatment of radiation diffusion with tabulated values of opacity and energy, the flux is defined as an integral whose derivative involves only values of the opacity; and the tabulated energy is replaced by a continuously differentiable function of temperature by the use of the spline fit. The same holds true with interfaces and various boundary conditions. (auth)

41741 (LNF-63/44) PRODUCTION OF CHARGED INTERMEDIATE BOSONS IN HIGH-ENERGY NEUTRINO EXPERIMENTS. Note No. 205. G. von Gehlen (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali di Frascati). June 14, 1963. 21p.

The total cross section for the production of charged vector bosons by neutrinos in the electromagnetic field of a nucleus is calculated for different boson masses and nuclei. The spin summations and one integration are performed explicitly. Near threshold the cross section is found to obey a $^7/_2$-power law. An explicit expression for the coherent part of the cross section at high neutrino energies is given. For the incoherent contribution the Fermi motion of the nucleons in the target nucleus is taken into account. (auth)

41742 (LNF-63/61) COMPLETE SPIN TESTS FOR FERMIONS. Note No. 211. M. Ademollo and R. Gatto (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali di Frascati). Sept. 5, 1963. 21p.

The complete spin tests for fermions of arbitrary spin, produced from a spin zero boson on an unpolarized spin $^1/_2$ fermion and decaying into a spin zero boson and a spin $^1/_2$ fermion are derived. The tests constitute the set of necessary and sufficient conditions for the particular spin assignment, in the absence of more detailed dynamical information. Essential use is made of the R-invariance of the production process (following from parity conservation). More general tests, applicable to arbitrary production processes, are also discussed. (auth)

41743 (NP-13127) ZAMECHANIE O SOOTVETSVII MEZHDU TEORIEI VOZMUSHCHENII V KVANTOVOI TEORII POLYA I POLOSAMI REDZHE. (A Note on the Conformity of the Perturbation Theory in the Quantum Field Theory and Regge's Poles). A. D. Galanin (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki). 1963. 16p.

According to perturbation theory, the radiative corrections of pseudoscalar meson-nucleon scattering are considered as arising from the virtual neutral vector meson. The perturbation theory is shown not to be in agreement with Regge behavior of the scattering amplitude. (auth)

41744 (NYO-10561) A BUBBLE CHAMBER STUDY OF NEGATIVE MUON ABSORPTION IN CARBON. Leo M. Fatur (Carnegie Inst. of Tech., Pittsburgh). May 1963. Contract AT(30-1)-882. 75p.

Mesons(μ^-) from the synchro-cyclotron were stopped in a 6-in. propane bubble chamber, and the ratio of absorptions to decays was measured. The pion contamination of the beam was measured using three independent techniques to be (0.38 ± 0.08)%. Results from approximately 20,000 muon stops yield a ratio of absorptions to decays of $(8.90 \pm 0.24 \times 10^{-2})$. Assuming a muon lifetime against decay of (2.202 ± 0.004) μsec, a capture rate in carbon of $(0.404 \pm 0.011) \times 10^5$ sec^{-1} is obtained. Additional results were the prong energy distributions due to the absorptions in carbon of muons and pions respectively. (auth)

41745 (UCRL-10954) ONE-PION EXCHANGE IN THE $K^+ + p \rightarrow K^* + N^*$ REACTION. Gerson Goldhaber (California. Univ., Berkeley and California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1963. Contract W-7405-eng-48. 13p. (CONF-131-2)

From Topical Conference on Recently Discovered Resonant Particles, Athens, Ohio, Apr. 1963.

The reactions leading to four particles in the final state ($K^+ + p \rightarrow K + \pi + N + \pi$) are discussed with proton momentum of 1.96 Bev/c. It was found that these reactions are dominated by the double-resonance production $K^+ + p \rightarrow K^*(895) + N^*_{33}(1238)$ and also that data support a spin-zero meson exchange (π meson). (R.E.U.)

41746 (UCRL-10955) MESON EXCHANGE IN $K^+ + p$ INTERACTION. Sulamith Goldhaber (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1963. Contract W-7405-eng-48. 14p. (CONF-131-3)

From Topical Conference on Recently Discovered Resonant Particles, Athens, Ohio, Apr. 1963.

A study was made of the $K^+ + p$ interaction at 1.96 Bev/c, which leads to three particles in the final state. The dynamics of the interaction are discussed, and a status report is given on the production of the K*(730) resonance and the branching ratio of the K*(890) decay. (R.E.U.)

41747 LEPTONS IN THE ISOSPACE $\mathfrak{C}(R^c_3)$. Pierre Hillion. Acta Phys. Polon., 24: 31-43(1963). (In English)

After giving the isobaric spin multiplets built on the polynomials $\varphi(\omega^*)$ of the isospace $\mathfrak{C}(R^c_3)$ and after recalling their transformation laws under the invariance group of strong interactions and under the gauge group, it is shown that leptons can be associated with some polynomials $\varphi(\omega^*) \in \mathfrak{C}(R^c_3)$ so that the sets $(\varphi_e, \varphi_{\nu e})$ and $(\varphi_\mu, \varphi_{\nu\mu})$ do not constitute isospinors which exclude the possibility of strong interactions for leptons. Then, afterwards, the Lagrangian of strong interactions is discussed. (auth)

41748 CONSISTENT FORMULATION OF THE CHEW-LOW THEORY FOR MESON-NUCLEON SCATTERING. Andrzej Kotanski (Jagellonian Univ., Krakow). Acta Phys. Polon., 24: 73-8(1963). (In English)

By choosing the cutoff value P = 4 and by taking into account one CDD pole, good agreement of the Chew-Low theory with the experimental data for $\pi-N$ scattering up to about 500 Mev was achieved. (auth)

41749 NEW FORMULATION OF THE STATISTICAL THEORY OF MULTIPLE PARTICLE PRODUCTION. R. Raczka (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Polon., 24: 79-89(1963). (In English)

Using the angular momentum representation for relativistic particles, a formulation of Fermi model is given in which the conservation of total energy, momentum, and angular momentum are taken into account along with other symmetries. A transition probability for arbitrary reaction is expressed in terms of new quantum numbers. Then a formulation of the Fermi model and final formulas for transition probability are given. A second possible approach to the statistical theory of multiple particle production is outlined. Some applications are discussed. (M.C.G.)

41750 INTERACTIONS OF 12.8-Bev PROTONS IN NUCLEAR EMULSIONS. I. GENERAL RESULTS. J. Catala, E. Villar, A. Lleo, G. Pardo, R. Llosa, J. L. Gomez, and R. Perez (Universidad, Valencia). Anales Real Soc. Esp. Fis. Quim. (Madrid), Ser. A, 59: 47-52(Mar.-Apr. 1963). (In Spanish)

Some 192 stars produced by 12.8-Bev protons in photographic emulsions were found and analyzed along 66.4 meters of track. A mean free path of 35 ± 2 cm and σ_{total} = 354 ± 27 mb were found. The multiplicity mean value is 3.8 ± 0.4 and shows a slight increase with the number of heavy tracks. (auth)

41751 DISPERSION THEORY METHODS FOR PION-DEUTERON ELASTIC SCATTERING. PART I. J. J. Brehm (Naval Ordnance Lab., Silver Spring, Md. and Univ. of Maryland, College Park) and J. Sucher. Ann. Phys. (N. Y.), 25: 1-47(Oct. 1963).

The problem of low energy π meson-deuteron elastic scattering is undertaken using the methods of dispersion theory. Complex singularities do not occur if the momentum transfer is used as the variable in a dispersion relation with the energy taken to be fixed and real. Anomalous discontinuities are developed by analytic continuation in the deuteron mass. Subsequent analytic continuation in the energy provides the representation of the physical amplitude. A sample calculation is made, ignoring spin. The contributions of π meson-nucleon scattering are estimated by assuming the dominance of the $T = 3/2$ resonance in the energy channel and of the ABC resonance in the momentum transfer channel. The angular distribution is computed at 85 Mev and some agreement with experimental data is obtained. (auth)

41752 A NOTE ON THE TRANSITION OPERATOR FOR NUCLEON-NUCLEON SCATTERING IN THE PRESENCE OF A HARD CORE. O. Brander (Chalmers Univ. of Tech., Göteborg). Arkiv Fysik, 24: 439-49(1963). (In English)

Starting from the conventional definition of the transition operator in formal scattering theory, a modified definition is derived, which can be used when the interaction contains a hard core. When used in the Chew formulation of the impulse approzimation, this definition is exactly equivalent to the one used by Kowalski and Feldman, but in the Watson formulation there is a difference between the two definitions. It is shown that this difference is small, except at high energies. (auth)

41753 $K\pi$ SCATTERING. B. Margolis and A. Rotstein (McGill Univ., Montreal). Can. J. Phys., 41: 1651-62(Oct. 1963).

The s-wave $K\pi$ phase shifts for the two isospin states $T = 1/2$ and $T = 3/2$ are calculated on the basis of a variational method due to Schiff by assuming a quartic boson-boson interaction. The trial forms for the state functions are optimized by making the expectation value of the field Hamiltonian stationary. The trial functions used are of separable form and it is hoped that with the development of more elaborate functions, this variational method may lead to a description of the $K\pi$ resonances. In particular, the vacuum single-particle, and two-particle (scattering and bound) states are investigated. The results are compared with the effective-range formula for $K\pi$ scattering developed by Lee (1960). (auth)

41754 FACTORIZATION FORMULA IN THE CALCULATION OF INELASTIC CROSS SECTIONS NEAR RESONANCES. Gisèle Bordes and Bernard Jouvet. Compt. Rend., 257: 1007-10(July 29, 1963). (In French)

A factorization formula is demonstrated on the example of inelastic scattering $K^+ + p \rightarrow K^0 + \pi^+ + p$ near the K* resonance. The general formula is applicable to all cross sections of this type. (tr-auth)

41755 ELECTROPRODUCTION OF PIONS WITH 3/2 RESONANCE IN THE ISOBARIC MODEL. Jean-Marie Abillon. Compt. Rend., 257: 1011-14(July 29, 1963). (In French)

The electron-proton inelastic cross section was calculated in the vicinity of the $^3/_2$ resonance, with the aid of a factorization method. A study of the experimental results permits a determination of the $\gamma_{pp\pi}$ interaction structure by its coupling constant ϵ_p and its form factor. (tr-auth)

41756 SCATTERING OF K^+ MESONS ON PROTONS AT THE 3/2 RESONANCE. Gisèle Bordes. Compt. Rend., 257: 1228-30(Aug. 5, 1963). (In French)

A calculation is presented of the differential inelastic-scattering cross section for K^+-p interactions near the 3/2 resonance, using a factorization method in the isobaric model. (tr-auth)

41757 DETERMINATION OF THE TENSORIAL PARAMETERS OF THE DEUTERON-PROTON SCATTERING (INCIDENT ENERGY OF 22 Mev). René Beurtey, Robert Chaminade, Alain Falcoz, Takashi Mikumo, André Papineau, Jean Saudinos, Larry Schecter, and Jacques Thirion (Centre d'Études Nucléaires, Saclay, France). Compt. Rend., 257: 1267-70(Aug. 5, 1963). (In French)

Two tensorial polarization parameters are measured for (d-p) scattering, using 22-Mev polarized deuterons as the incident particles. The angular distributions and their parameters are presented. (tr-auth)

41758 PHENOMENOLOGICAL ANALYSIS OF HYPERNUCLEAR BONDS. A. M. Kol'chuzhkin and N. N. Kolesnikov (Moscow State Univ.). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 4, 19-25(1963). (In Russian)

Phenomenological analysis of hypernuclear bonding energies was used as a basis for determining square radius and volume integrals in Λ-N interactions. Excited levels of light hypernuclei and saturated energies of heavy hypernuclei were investigated. (tr-auth)

41759 ON ANTIPROTON MODERATION IN A SUBSTANCE AT MEDIUM ENERGIES. Yu. D. Fiveiskii (Moscow Inst. of Engineering Physics). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 4, 93-9(1963). (In Russian)

Antiproton moderation in a substance at energies between one and two π^0 production was studied. It is shown that antiprotons are absorbed primarily by nuclei, and the number of antiprotons during the moderation process remains almost unchanged. (tr-auth)

41760 KINETIC EQUATION FOR MULTIPLE SCATTERING OF DIRAC PARTICLES. I. N. Toptygin (Leningrad Polytechnic Inst.). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 4, 142-8(1963). (In Russian)

Graphical techniques were used for developing pair interactions, describing multiple Dirac particle scattering in a uniform isotropic medium. (tr-auth)

41761 THE STRUCTURAL CHEMISTRY OF COMPLEX FLUORIDES OF GENERAL FORMULA $A^IB^VF_6$. R. D. W. Kemmitt, D. R. Russell, and D. W. A. Sharp (Imperial Coll. of Science and Tech., London and Royal Coll. of Science and Tech., Glasgow). J. Chem. Soc., 4408-13(Sept. 1963).

The complex fluorides $A^IB^VF_6$ were found to fall into five structural types. The relation of ions A and B, which the structure adopted depends on, is discussed. New preparations are also given for some complexes of the general type. (P.C.H.)

41762 MOMENTUM DISTRIBUTION OF THE Λ IN THE REACTION $\Sigma^- + d \rightarrow \Lambda + 2n$. Jean Cortois and Marcel Deboudt (Faculté des Sciences, Lille, France). J. Phys., 24: 391-3(June 1963). (In French)

The rate of the $\Sigma^- + d \rightarrow \Lambda + 2n$ reaction is studied as a function of the Λ momentum and transition matrix parameters in the spin space for the $\Sigma^- + p \rightarrow \Lambda + n$ reaction. The impulse approximation is used and the Λ parity relative to Σ^- supposed even. Pauli's principle is considered in the final state. (auth)

41763 MAXIMUM LIKELIHOOD ESTIMATES OF SHORT LIFETIMES MEASURED WITH BACKGROUND. J. Martin-Loef (Nobel Inst. of Physics, Stockholm). Nucl. Instr. Methods, 24: 31-8(July 1963). (In English)

An experiment is studied in which the time intervals between "birth" and "death" of shortlived particles are measured. The finite resolution and range of the equipment and also the background are considered in the mathematical model. Maximum-likelihood estimates of the relevant parameters are obtained and also the errors in the estimates. The consistency between model and experimental result is tested. A computer program, TINTAN, written in ALGOL, is constructed to do the numerical work. (auth)

41764 SYMMETRY PROPERTIES IN BEAM TRANSPORT SYSTEMS. J. McL. Emmerson and N. Middlemas (Oxford Univ.). Nucl. Instr. Methods, 24: 93-102(July 1963). (In English)

The effect of a beam transport element is given by a general transformation function, which includes both transfer matrix and aberration terms. Restrictions imposed by the symmetry properties of the element are used to express this transformation function in terms of a minimal set of parameters. It is thus possible to eliminate the internal inconsistencies in a set of measurements on the element, and to order such a set so that it yields the maximum information. The theory is illustrated by an example in which the parameters are derived (and thus the element completely described) using only a very simple set of measurements. (auth)

41765 CORRELATIONS IN STRANGE-PARTICLE PAIRS PRODUCED BY π^- OF 6, 11 AND 18 Gev/c. J. Bellière (Ecole Polytechnique, Paris), M. Bloch, D. Drijard, et al. Nuovo Cimento (10), 29: 339-70(July 16, 1963).

Interactions of π^- of 6.1, 11.6, and 18.1 Bev/c from the CERN PS on protons or quasifree neutrons were studied in the Ecole Polytechnique one-meter bubble chamber filled with a mixture of 86% propane and 14% freon by volume. Interactions were selected in which two neutral strange particles are visible in order to study correlations among the strange particles and to study separately the behavior of the K_1^0's from the reaction $\pi^- + n \rightarrow K^0 + \overline{K}^0 + n\pi + n$ and $\pi^- + n \rightarrow K^0 + \Lambda(\Sigma^0) + n\pi$. It is found that πp c.m.s. longitudinal and transverse momentum distributions are similar for the K_1^0's from $K^0\overline{K}^0$ and from K^0Y^0 pairs. They tend to go forward in the c.m.s., small momenta being most probable. The baryon (Λ or nucleon) tends to go backward in the c.m.s. but with longitudinal momentum distributed roughly uniformly from slightly forward to the maximum kinematically possible backward. The K_1^0's of $K_1^0K_1^0$ pairs tend to have relative energy that is only a small fraction of the available with a distribution roughly independent of the π^- beam momentum and of the πp c.m.s. momentum of the $K_1^0K_1^0$ system. This effect does not seem to be due to phase-space limitations arising from backward peaking of the nucleon. Events present are too few to decide whether this low-energy peaking of the Q-values is due to a resonance near 1.1 Bev or to a strong low-energy $K^0\overline{K}^0$ interaction. Clear evidence of K^* (0.89 Bev) and to a lesser degree of Y_1^* (1.39 Bev) are seen in $K^0\Lambda$ production. (47 ± 15)% of all $K_1^0\pi^+$ systems are $(K^*)^+$, (30 ± 20)% of all $\Lambda\pi$ systems are Y_1^*. No evidence is seen of K^* production in $K_1^0K_1^0$ producing jets. (auth)

41766 MINIMAL INTERACTIONS. C. G. Bollini (Física de la Facultad de Ciencias Exactas, Buenos Aires). Nuovo Cimento (10), 29: 371-9(July 16, 1963).

The Klein-Gordon equation is taken as the fundamental wave equation for free particles. The subsidiary equations are treated only as initial conditions, and a minimal interaction is defined as one which conserves the supplementary conditions. The minimal interaction with the electromagnetic field of spin $s = 0$, $\frac{1}{2}$, and 1 particles is found, and the equivalence with the usual treatment for $s = 0$ and $\frac{1}{2}$ is shown. For $s = 1$ the Young and Mills nonlinear coupling is obtained. The minimal coupling is also found for pseudoscalar particles in interactions with nucleons. The resultant minimal theory is equivalent to the usual pseudoscalar coupling theory. (auth)

41767 LEPTONIC DECAYS IN FINITE SPACE. Q. A. M. M. Yahya (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 29: 441-50(July 16, 1963).

It is shown that the concept of the configurational space of field theory consists of a finite number of points can explain the decay processes in a better way. The selection rules with quantum numbers, which arise in the representation of the finite Lorentz group, forbid all unwanted leptonic decays and allow all observed ones. An almost similar situation is obtained for nonleptonic decays. Also the finiteness-of-points rules out the divergences as all integrals become finite sums. (auth)

41768 HIGH-ENERGY BEHAVIOUR OF ELECTRODYNAMICAL CROSS SECTIONS. P. Budini and G. Furlan (Università, Trieste, Italy and Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Nuovo Cimento (10), 29: 451-62(July 16, 1963).

The contribution of the soft photons to the high-energy electrodynamical cross sections is investigated. In particular the appearance of $\alpha \ln^2(E/m)$ terms in the perturbative expansion are discussed. Particular cases are considered. (auth)

41769 A SIMPLE METHOD FOR MEASURING THE PROBABILITY OF THREE-QUANTUM ANNIHILATION. G. Fabri, E. Germagnoli, G. Poletti, and G. Randone (CISE, Milan). Nuovo Cimento (10), 29: 500-6(July 16, 1963).

A method is described that allows the measurement of the probability of three-quantum annihilation in a material, after comparison with another material in which positronium formation does not take place. No coincidence measurements are needed, as only the intensities of annihilation γ lines (0.51 Mev) in both materials are compared. (auth)

41770 THE POLARIZATION OF PROTONS RECOILING FROM $\pi^+ + p$ COLLISIONS AT 265 Mev. D. G. Davis, A. Ghani, R. C. Hanna, F. F. Heymann, G. Heymann, and A. L. Read (CERN, Geneva). Nuovo Cimento (10), 29: 507-14(July 16, 1963).

The polarization of protons recoiling at 23° in the laboratory from $\pi^+ + p$ elastic collisions at 265 Mev was measured using carbon as an analyzer, together with a system of large directional counters. The polarization was found to be -0.11 ± 0.007. The inclusion of these data with existing information on differential and total cross sections at this energy strengthens the case for the inclusion of D-waves in a phase-shift analysis at this energy. (auth)

41771 π^-p INTERACTIONS AT 1.59 Gev/c. J. Alitti (Laboratoire de Physique Corpusculaire à Haute Energie, Saclay, France), J. P. Barton, A. Berthelot, et al. Nuovo Cimento (10), 29: 515-42(July 16, 1963).

A report is given on the investigation of interactions in π^-p collisions at a pion momentum of 1.59 Bev/c, by means of the 50-cm Saclay liquid-hydrogen bubble chamber, operating in a magnetic field of 17.5 kG. The results obtained concern essentially the elastic and the inelastic scattering accompanied by the production of either a single pion in $\pi^-p \rightarrow p\pi^-\pi^0$ and $n\pi^-\pi^+$ interactions, or by more than one pion in four-prong events. The observed angular distribution for the elastic scattering in the diffraction region can be approximated by an exponential law. From the extrapolated value, thus obtained for the forward scattering, one gets $\sigma_{el} = (9.65 \pm 0.30)$ mb. Effective mass spectra of $\pi^-\pi^0$ and $\pi^-\pi^+$ dipions are given in case of one-pion production. Each of them exhibits the corresponding ρ^- or ρ^0 resonances in the region of $\sim 29\mu^2$ (μ = mass of the charged pion). The ρ peaks are particularly conspicuous for low momentum transfer (Δ^2) events. The ρ^0 distribution presents a secondary peak at $\sim 31\mu^2$ due probably to the $\omega^0 \rightarrow \pi^-\pi^+$ process. The branching ratio $(\omega^0 \rightarrow \pi^+\pi^-)/(\omega^0 \rightarrow \pi^+\pi^-\pi^0)$ is estimated to be ~7%. The results are fairly well interpreted in the frame of the peripheral interaction according to the one-pion exchange model, up to values of $\Delta^2/\mu^2 \sim 10$. In particular, the ratio ρ^-/ρ^0 is of the order of 0.5, as predicted by this model. Furthermore, the distribution of the Treiman-Yang angle is compatible with an isotropic one inside the ρ peak. The distribution of $\sigma_{\pi^+\pi^-}$, as calculated by the use of the Chew-Low formula assumed to be valid in the physical region of Δ^2, gives a maximum which is appreciably lower than the value of $12\pi\lambda^2 = 120$ mb expected for a resonant elastic $\pi\pi$ scattering in a $J = 1$ state at the peak of the ρ. However, a correcting factor to the Chew-Low formula gives a fairly good agreement with the expected value. Another distribution namely the Δ^2 distribution, at least for $\Delta^2 < 10\mu^2$, agrees quite well with the peripheral character of the interaction involving the ρ resonance. π^- angular distributions in the rest frame of the ρ exhibit a different behavior for the ρ^- and for the ρ^0. Whereas the first one is symmetrical, as was already reported in a previous paper, the latter shows a clear forward π^- asymmetry. The main features of the four-prong results include the occurrence of the $\frac{3}{2}\,\frac{3}{2}$ $(p\pi^+)$ isobar in $\pi^-p \rightarrow p\pi^+\pi^-\pi^-$ events and the possible production of the $\omega^0 \rightarrow \pi^+\pi^-\pi^0$ resonance in $\pi^-p \rightarrow p\pi^-\pi^+\pi^-\pi^0$ events. No ρ's were observed in four-prong events. (auth)

41772 A NOTE ON SALAM's COMPOSITENESS CONDITIONS. J. S. Dowker (Univ. of Pennsylvania, Philadelphia). Nuovo Cimento (10), 29: 551-4(July 16, 1963).

It has been suggested that a particle may be treated as elementary and be included in the Lagrangian if its wavefunction renormalization constant and its dissociation-vertex renormalization constant are both zero. This is discussed using a model that consists of two particles A and B and one distinct antiparticle B. The only basic interactions allowed are $A \longleftrightarrow B + \overline{B}$ and $B + \overline{B} \longleftrightarrow B + \overline{B}$. There are no states coupled to the single-particle B and $\overline{B}$ states. (R.E.U.)

41773 APPROXIMATION FUNCTION FOR THE $^1S_0$ PROTON-PROTON EFFECTIVE RANGE. H. Cornille (Faculte de Sciences, Orsay, France). Nuovo Cimento (10), 29: 555-60(July 16, 1963). (In French)

41774 K^* (725) AS A SYMMETRY-BREAKING AGENT. D. Horn (Tel Aviv Univ., Jerusalem). Nuovo Cimento (10), 29: 571-3(July 16, 1963).

The zero spin and positive parity of a recently observed $K-\pi$ resonance at 725 Mev are discussed. It is concluded

that $^{+}_{0}K$ appears only when unitary symmetry is broken. (R.E.U.)

41775 REGGE TRAJECTORIES FOR POTENTIAL SCATTERING AT NEGATIVE ANGULAR MOMENTA. P. Kaus (Univ. of California, Riverside). Nuovo Cimento (10), 29: 598-610(Aug. 1, 1963).

The behavior of Regge trajectories is studied for certain classes of potentials. The asymptotic properties are found to depend on the behavior of the potential at the origin as expected. In particular weak potentials with attractive and repulsive cores are studied. In all cases there are indeterminacy points (crossings of $\alpha_n(k)$ and $\alpha_m(-k)$) at positive and negative energies and branch points (crossings of $\alpha_n(k)$ and $\alpha_m(k)$). Some trajectories are seen to lie down at negative integer and half-integer l-values. (auth)

41776 ISOSCALAR NUCLEAR STRUCTURE AND MULTI-PION RESONANCES. K. Kawarabayashi (Tokyo Univ.) and A. Sato.. Nuovo Cimento (10), 29: 611-16 (Aug. 1, 1963).

The general features of the effects of multi-pion resonances on the isoscalar nucleon structure are investigated with a particular attention to the possible role of ρ and ω mesons. It is shown that the observed isoscalar charge structure of the nucleon can be accounted for in terms of the three-pion state contribution with a proper choice of ρ and ω meson widths. A dependence of the calculated values on these resonance widths is also examined. (auth)

41777 GAUGE INVARIANCE AND MASS IN A TWO-DIMENSIONAL MODEL. L. S. Brown (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 29: 617-43(Aug. 1, 1963).

A model theory consisting of quantum electrodynamics with vanishing electron mass and in a space-time world of two dimensions is investigated with simple techniques. A complete solution is obtained, and it is found to be perfectly finite and to possess a massive single-particle state that may be interpreted as a massive photon. The noncommutativity of the charge and current densities at equal times plays a crucial role in the construction of the solution. Although the theory is invariant under constant γ_5 gauge transformations, the corresponding chiral current is not conserved. The vector field analog to the electrodynamic model is also discussed. The consistent generation of the covariant field equations by the hamiltonian is obtained by a careful definition of the bilinear products of charge fields that it contains. However, a consistent solution of the vector field model cannot be obtained with the methods successful in the electrodynamic case. (auth)

41778 DYNAMICS OF SPINNING PARTICLES IN CLASSICAL AND QUANTUM THEORY. G. Szamosi (National Research Council of Canada, Ottawa). Nuovo Cimento (10), 29: 677-86(Aug. 1, 1963).

The equations of motion of various classical relativistic theories are considered and compared with the (Lorentz) covariant one-particle quantum equations. A remarkable formal analogy is found in the case of a free particle. The various classical theories correspond to different aspects of the actual quantum equations of motion if an external field is present. (auth)

41779 SPIN-ONE MULTIPION RESONANCES AND THEIR POSSIBLE ROLE IN DISTINGUISHING BETWEEN THE μ-MESON AND THE ELECTRON. J. H. Baroff and T. Fulton (Johns Hopkins Univ., Baltimore). Nuovo Cimento (10), 29: 687-702(Aug. 1, 1963).

Photons, heavy vector mesons (HVM), and their interactions are considered from a Lagrangian point of view. The simplest non gauge-invariant and gauge-invariant photon-HVM interactions are introduced and then eliminated through diagonalization. A model of the interactions of the photon and the HVM fields with the leptons, motivated by the large $\mu-e$ mass difference, is considered. A selection rule, preventing the coupling of the original photon field to the μ-meson and the HVM field to the electron, is assumed. The original photon-HVM interactions then generate a photon-μ interaction. A large asymmetry in the coupling of the HVM to the electron and the μ-meson can be induced by demanding that the photon field corresponding to the diagonalized Lagrangian couple with the same strength, e, to both leptons. A brief review of the limits provided on the mass and couplings of the HVM by current experimental information is presented, with particular emphasis on the ρ and ω-mesons as candidates for the HVM. Previously proposed experiments are discussed from the point of view of providing tests of the asymmetric coupling of the HVM to the leptons. Quite aside from the model proposed for this asymmetric coupling, the present work emphasizes the need to eliminate direct photon-HVM couplings in making phenomenological perturbation theory estimates of various processes involving such bosons. (auth)

41780 GOLDBERGER-TREIMAN FORMULAE WITH REGGE PHASE SHIFTS. B. Barrett and G. Barton (Clarendon Lab., Oxford). Nuovo Cimento (10), 29: 703-19(Aug. 1, 1963).

If the nucleon-antinucleon phase shifts display a Regge behavior as the energy tends to infinity, then the $\pi . r . \bar{r}$ form factor tends to a constant, and the original derivation of the Goldberger-Treiman formulas for $\pi \rightarrow \mu\nu$ and $\pi^0 \rightarrow 2\gamma$ fails, because certain crucial dispersion integrals diverge. The formulas are derived in the original approximation, in which baryon loops dominate, but with the Regge high-energy behavior. It is only assumed that a solution exists; if it does, it is unambiguous and independent of the number of subtractions that may be necessary. But with no subtraction there is a built-in self-consistency criterion that is violated unambiguously in $\pi \rightarrow \mu\nu$. This points to a direct π-lepton coupling; both renormalized and unrenormalized coupling constants are calculated. By including all baryon loops, and using the eightfold way predictions, reasonable if provisional agreement with experiment is obtained for $\pi^0 \rightarrow 2\gamma$. Here the problem of subtractions is less clear-cut. If virtual baryon loops dominate also in $\eta \rightarrow 2\gamma$, which may be, but need not be, the case, then the partial width is predicted to lie between 30 and 60 ev. Since this is much less than the value recently quoted on different theoretical grounds, a measurement of the width may discriminate between the different physical models for the decay. (auth)

41781 UNITARY SYMMETRY AND THE WEAK CURRENTS. D. Horn and Y. Ne'eman (Tel Aviv Univ., Israel and Israel Atomic Energy Commission, Rehovoth). Nuovo Cimento (10), 29: 760-70(Aug. 1, 1963).

The structure of the weak currents is discussed in the light of unitary symmetry. The known leptonic interaction modes of the hadrons are listed and it is shown that they imply the inclusion of more currents than the ones derived from gauge invariance. Several tests of the proposed symmetry are discussed. A short theoretical study shows that renormalization effects should be felt in the limit of unitary symmetry, but can be avoided if higher groups than SU_3 are taken into account. (auth)

41782 AN APPLICATION OF THE BOHM-PINES EQUATION TO A SYSTEM OF INTERACTING BOSONS. E. Borchi and M. Poli (Università, Florence). Nuovo Cimento (10), 29: 777-9(Aug. 1, 1963).

Previous results for the ground-state and free energy of a system of interacting bosons at finite temperature are rederived by means of the Bohm-Pines equation. (C.E.S.)

41783 A SELECTION RULE FOR THE PRODUCTION OF PIONS IN THE STEADY-STATE THEORY. G. Velo (Università, Bologna). Nuovo Cimento (10), 29: 780-1 (Aug. 1, 1963).

The process of continuous production of mesons (π) and nucleons that is characteristic of the steady-state theory is considered. By making reasonable assumptions on the energy distributions of the particles when created the flux at each point in space and on earth can be calculated. It is found statistically that meson (π) production is extremely predominant over nucleon production, which contradicts experimental cosmic nucleon flux measurements. A selective rule is imposed that prohibits the production of mesons (π) to compensate the difference in experimental and statistical results. (C.E.S.)

41784 ANGULAR CORRELATIONS AT SOME MULTIPARTICLE ANNIHILATION OF SLOW ANTIPROTONS. J. Werle, St. Dymus, and T. Zielinski (Univ. of Warsaw). Phys. Letters, 6: 264-6(Sept. 15, 1963). (In English)

Angular correlations and polarizations are studied to supply further information about mechanisms of multiparticle processes. (R.E.U.)

41785 THE ρ MESON IN THE ELECTRO AND K PRODUCTIONS OF N^*_{33}. B. Jouvet, J. M. Abillon, and G. Bordes (Collège de France, Paris). Phys. Letters, 6: 273-6 (Sept. 15, 1963). (In English)

The experiments analyzed to show the similarity of relative weights of each state in the three processes were: $e + p \rightarrow e + p^* \rightarrow e + \begin{cases} p + \pi^0 \\ n + \pi^+ \end{cases}$; and $K^+ + p \rightarrow K^0 + p^{3+} \rightarrow K^0 + \pi^+ + p$. The values of the proportionality factors, with which they occur, are determined. The results are interpreted in terms of the ρ-meson. (R.E.U.)

41786 EVIDENCE FOR $\omega \rightarrow \pi^0 + \gamma$ DECAY. V. V. Barmin, A. G. Dolgolenko, Yu. S. Krestnikov, A. G. Meshkovskii, Yu. P. Nikitin, and V. A. Shebanov (Inst. of Theoretical and Experimental Physics, Moscow). Phys. Letters, 6: 279-82(Sept. 15, 1963). (In English)

The reaction $\pi^- + p \rightarrow n + \omega$ was investigated using a bubble chamber filled with a mixture of propane and xenon. Photographs were obtained for meson(π^-) momenta of 1.25, 1.55, and 2.8 Bev/c. (R.E.U.)

41787 RESONANCE SCATTERING THEORY. A. Herzenberg and F. Mandl (Univ. of Manchester, Eng.). Phys. Letters, 6: 288-9(Sept. 15, 1963). (In English)

A resonance scattering formalism is given, which does not depend on a joining radius r_0, to definte an internal region. An expansion is obtained of the S-matrix whose individual terms are independent of r_0. The formulation is in terms of an orthonormal set of functions and is illustrated by considering s-wave scattering by a short-range potential. (R.E.U.)

41788 INVESTIGATION OF $K^-\pi^-$ AND K^-p INTERACTIONS. A. Barbaro-Galtieri, A. Hussain, and R. D. Tripp (Univ. of California, Berkeley). Phys. Letters, 6: 296-9 (Sept. 15, 1963). (UCRL-10885) (In English)

The reaction $K^-n \rightarrow K^-\pi^-p$ was studied for an incident K^- momentum of 1.51 Bev/c. The possibility of $K\pi$ resonance in $T = 3/2$ was investigated using a pure isotopic spin channel free from obscuring effects of K^* (888 Mev), which dominates the $T = 1/2 K\pi$ interaction in this mass region. (R.E.U.)

41789 POLE APPROXIMATION MODEL IN HYPERON DECAYS AND UNITARY SYMMETRY. E. Eberle and S. Iwao (Università, Genoa and Istituto Nazionale di Fisica Nucleare, Genoa). Phys. Letters, 6: 302-4(Sept. 15, 1963). (In English)

The parameters appearing in the theory are studied as to be consistent with the experimental information in the Σ- and Λ-hadronic decays. The effect was studied of the kaon-pole contribution relative to the baryon-pole contribution by making use of the K-π direct weak coupling constant, the sign of the asymmetry parameter of the Ξ^--decay, and the decay probability of the Λ-hyperon by making use of the precedently determined parameters. (R.E.U.)

41790 A TEST OF THE COMPOSITE NATURE OF MESON ρ WITH THE NUCLEON FORM FACTOR. B. Jouvet (Collège de France, Paris). Phys. Letters, 6: 307-9(Sept. 15, 1963). (In French)

It is shown that the hypotheses of universal coupling of the ρ meson, and of the composite nature of this meson, imply certain properties of the isovector form factors of the nucleon. (T.F.H.)

41791 ANGULAR CORRELATIONS IN THE DECAY OF THE K^* AND N^* STATES. G. B. Chadwick (Oxford Univ.), D. J. Crennell, W. T. Davies, et al. Phys. Letters, 6: 309-12(Sept. 15, 1963). (In English)

For the production of single pions by K^+ mesons at 1.455 Bev/c, the relative importance of the single meson exchange amplitudes resulting from the exchange of either a pseudoscalar or a vector meson was studied by analysis of angular correlations in the decay of the K^* and N^* states that are formed. (R.E.U.)

41792 PRELIMINARY RESULTS ON $\Xi^- + K^0 + n\pi$ FINAL STATES PRODUCED BY 3.5 Gev K^-. P. Bellière (Ecole Polytechnique, Paris), V. Brisson, P. Petiau, et al. Phys. Letters, 6: 316-18(Oct. 1, 1963).

Negative results are reported of a search for a predicted strangeness -3 hyperon and for possible $S = -2$, $I = 3/2$ resonances in $\Xi + K + n\pi$ final states. Evidence is presented for the production of Ξ_δ (1.53 Bev) by 3.5-Bev K^- with confirmation of isospin of $1/2$. (R.E.U.)

41793 SOME PROPERTIES OF THE φ-MESON, AND ITS EFFECTS ON THE DECAY OF THE η-MESON. M. Ichimura and K. Yazaki (Tokyo Univ.). Phys. Letters, 6: 345-7(Oct. 1, 1963).

Unitary symmetry of strong interactions is assumed. Experimental facts of the φ and η meson are summarized. (R.E.U.)

41794 SCATTERING OF ELECTROMAGNETIC WAVES BY AN ELECTRON–PHONON SYSTEM. Amiram Ron (Princeton Univ., N. J.). Phys. Rev., 132: 978-85(Nov. 1, 1963).

A theory is developed that described the scattering of electromagnetic waves by the electron density fluctuation of an electron-phonon system. The frequency spectrum of the scattered radiation is calculated by the temperature-dependent Green's function method and is alternatively derived by an elementary treatment in terms of dressed electrons and phonons. The theory may find its application in the study of incoherent scattering of electromagnetic waves in the vacuum ultraviolet region by thin metals. The

resulting frequency spectrum of the scattered radiation shows resonances corresponding to the collective response of the electrons to the lattice vibrations, and to the collective excitation of plasma oscillations. (auth)

41795 HIGH-ENERGY DIFFRACTION SCATTERING. Loyal Durand, III, and Kenneth R. Greider (Yale Univ., New Haven). Phys. Rev., 132: 1217-25(Nov. 1, 1963).

The experimental data of Foley et al. on elastic proton-proton scattering were analyzed in a phenomenological manner using the impact-parameter representation for the scattering amplitude in the form given by Blankenbecler and Goldberger. The detailed shape and energy dependence of the elastic differential cross section, the small ratio of the elastic-scattering cross section to the total cross section, and the constant total cross section can all be explained with remarkable ease using a smooth weight function with reasonable properties. Two cases were considered. In the first, the scattering amplitude was assumed to be purely imaginary. In order to account for the observed narrowing of the elastic diffraction peak, considered as a function of the square of the invariant momentum transfer t it is then necessary that the radius of the interaction region increase, and its opacity decrease, with increasing energy. The necessary energy dependence cannot be determined uniquely, but is consistent with that expected on the basis of semiclassical considerations. However, some unexpected difficulties are encountered at the lower momenta, and evidence is adduced for the existence of a significant real part of the scattering amplitude for moderate values of $|t|$. The consequences of a nonzero real amplitude were investigated in a second model. It was found that the shrinking of the diffraction peak can be explained using real and imaginary amplitudes with fixed t dependence, with the magnitude of the former decreasing relative to that of the latter with the energy dependence expected on the basis of potential-scattering considerations. It is therefore not possible to conclude from the observed shrinking of the diffraction peak that a Regge pole mechanism is operative, or even that the effective radius of the absorptive region is increasing, without first establishing experimentally the behavior of the real part of the scattering amplitude for $t < 0$. The observation that $|\mathrm{Ref}(s,0)/\mathrm{Imf}(s,0)|^2 \ll 1$, as established using the optical theorem, is insufficient for this purpose. The π^--p elastic scattering data of Foley et al. were also analyzed. (auth)

41796 PION-PROTON DIFFRACTION SCATTERING AT VERY SMALL MOMENTUM TRANSFERS. I. R. Gatland and J. W. Moffat (Research Inst. for Advanced Studies, Baltimore). Phys. Rev., 132: 1225-6(Nov. 1, 1963).

The model of high-energy scattering based on a moving pole and a fixed cut in the angular-momentum plane is applied to π-p scattering at very small momentum transfers, and is found to agree with the experiments that give a departure from an exponential diffraction peak. (auth)

41797 ELECTROMAGNETIC PROPERTIES OF THE NEUTRINO. Jeremy Bernstein (New York Univ., New York), Malvin Ruderman, and Gerald Feinberg. Phys. Rev., 132: 1227-33(Nov. 1, 1963).

A detailed survey of the experimental information on the neutrino charge, charge radius, and magnetic moment is made. Both weak-interaction data and astrophysical results can be used to give precise limits to these quantities, independent of the supposition that the weak interactions are charge conserving. (auth)

41798 UNITARY SYMMETRY AND THE TRANSFORMATION $\eta \rightarrow \pi^0$. S. P. Rosen (Purdue Univ., Lafayette, Ind.). Phys. Rev., 132: 1234-9(Nov. 1, 1963).

The transformation $\eta \rightarrow \pi^0$, which is thought to play a dominant role in the decay mode $\eta \rightarrow \pi^+\pi^-\pi^0$, is examined in the light of unitary symmetry and several different models for η decay. Beside the models of Gell-Mann, Sharp, and Wagner (GSW), and of Barrett and Barton (BB), these include the strong coupling of pseudoscalar and vector meson octets with the unitary singlet vector meson φ, and the electromagnetic coupling of pseudoscalar and vector mesons. Group-theoretical methods are used to confirm that the contributions of all but one of the lowest order diagrams on the GSW model cancel one another. The same methods show that the cancellations in lowest order are not as serious for the BB model, and are nonexistent for models involving the φ meson. (auth)

41799 THEORY OF SPIN-$\frac{1}{2}$ PARTICLES WITH PARITY-NONCONSERVING INTERACTIONS. K. Hiida (Argonne National Lab., Ill.). Phys. Rev., 132: 1239-48 (Nov. 1, 1963).

It is shown that when interactions are not invariant under parity conjugation, both the self-mass term $(-\delta m\bar{\psi}\psi)$ and the term $(-a\bar{\psi}\gamma_\mu\gamma_5\partial\psi/\partial x_\mu)$ are induced by the self-interaction of any spin-$\frac{1}{2}$ particle with nonvanishing mass. (For simplicity T invariance is assumed.) When $a^2 > 1$, the spin-$\frac{1}{2}$ particle propagates in vacuum faster than the velocity of light. When $a^2 = 1$, the observed mass should be zero. Therefore, it follows that $a^2 < 1$ for any spin-$\frac{1}{2}$ particle with nonvanishing mass. Since $1 > a^2 > \frac{1}{3}$ implies the existence of ghost states, one must require $a^2 \leq \frac{1}{3}$. Although a has no physical meaning for free particles, as an example, it is also shown that it has a physical meaning when a charged particle is interacting with an external electromagnetic field. The value of a is estimated for the electron and the muon. (auth)

41800 VECTOR-MESON FIT TO NUCLEON FORM FACTORS. M. W. Kirson (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 132: 1249-51(Nov. 1, 1963).

Available data on nucleon electric and magnetic form factors were fitted with a dispersion theoretic formula, assuming the electron-nucleon scattering process dominated by the ρ, ω, and ϕ mesons and hard cores. The data are found to fit a smooth curve of the assumed form. The fit, based mainly on proton data, predicts neutron form factors compatible with experimental results. (auth)

41801 PION-PROTON ELASTIC SCATTERING FROM 3 Gev/c TO 5 Gev/c. M. L. Perl, L. W. Jones, and C. C. Ting (Univ. of Michigan, Ann Arbor). Phys. Rev., 132: 1252-72(Nov. 1, 1963).

Results of a spark chamber experiment on elastic scattering of pions on protons are presented and analyzed. The processes studied were π^+p at 2.92 Bev/c, and π^-p at 3.15, 4.13, and 4.95 Bev/c. The data are fitted to an exponential function of the four-momentum transfer, t, in several different ways in attempts to explore systematic energy and angular dependences. No shrinkage of the diffraction peak is seen in comparing the coefficients of a linear exponential fit for $|t| < 0.4$ (Bev/c)^2; at larger $|t|$, however, the cross section falls off with increasing energy. The large-angle differential cross section is examined for structure and is compared with all other large angle scattering data. The results are compared with proton-proton scattering data over the same energy range and substantial differences between the two processes are evident. (auth)

41802 EVIDENCE FOR THE REACTION $\pi^- + p \rightarrow \bar{p} + d$ AND SOME METHODS OF INVESTIGATING VIRTUAL NUCLEON EXCHANGE PROCESSES. M. L. Perl, L. W. Jones, and C. C. Ting (Univ. of Michigan, Ann Arbor). Phys. Rev., 132: 1273-7(Nov. 1, 1963).

The cross section for the process $\pi^- + p \rightarrow \bar{p} + d$ was studied in a spark chamber experiment and was found to be 16 ± 10 μb at 4.13 Bev/c and 8 μb at 4.95 Bev/c. The interpretation of this process in terms of a virtual nuclear exchange is discussed and comparison is made with other possible nucleon exchange reactions such as $p + p \rightarrow \pi^+ + d$ and backward pion-nucleon elastic scattering. There is a difficulty in applying Regge theory to these reactions because unequal masses are involved. (auth)

41803 PION-NUCLEON SCATTERING AND THE J = 2, T = 0 PION-PION INTERACTION. G. C. Oades (Univ. of London). Phys. Rev., 132: 1277-82(Nov. 1, 1963).

The effect of the J = 2, T = 0 $\pi-\pi$ interaction on the $\pi-N$ invariant amplitude, $B^{(+)}$ is analyzed. It is found that the $\pi-N$ scattering data are inconsistent with a J = 2, T = 0 $\pi-\pi$ phase δ_2^0 that rises to above 13° around 650 Mev. The data are consistent with a δ-function contribution at 1200 Mev but it is impossible to say whether this corresponds to a resonant phase or only a sharp peak in the corresponding absorptive part of the amplitude. (auth)

41804 INTERACTION OF POSITIVE PIONS WITH HYDROGEN AT 600 Mev. Peter C. A. Newcomb (Univ. of California, Berkeley). Phys. Rev., 132: 1283-92(Nov. 1, 1963). (UCRL-10682)

A hydrogen bubble chamber was used to investigtae π^+-p interactions at 600 Mev. There were 1738 good events, of which $71.9 \pm 0.8\%$ were elastic. Partial waves up to at least D_{5_2} are required to fit the elastic angular distribution. The inelastic evenis were almost entirely single-pion production. The ratio (p + 0)/(n++) was found to be 5.5 ± 0.8, which agrees well with 4.9 predicted by the $(3/2,3/2)$ pion-nucleon isobar model of Olsson and Yodh. It is also consistent with 6.5 predicted by Sternheimer and Lindenbaum. The pion momentum spectra and the $\pi-\pi$ Q-value distributions also support the Olsson and Yodh model. Thus the $(3/2,3/2)$ pion-nucleon isobar is apparently the principal mechanism for single-pion production at 600 Mev. Angular distributions for the single-pion-production data are presented. (auth)

41805 PHOTOPRODUCTION OF π^0 MESONS FROM HYDROGEN NEAR ZERO DEGREES. V. L. Highland and J. W. DeWire (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 132: 1293-7(Nov. 1, 1963).

Measurements of the differential cross section for photoproduction of π^0 mesons from hydrogen, with the pion emerging near 0 deg, in the photon energy range 290 to 700 Mev are reported. The results show no unusual behavior of the cross section in the forward direction. They are consistent with the angular distribution characteristic of a magnetic-dipole transition to a P_{3_2} state. The results agree reasonably well with theoretical predictions of Gourdin and Salin, but disagree with a prediction of DeTollis and Verganelakis. Least-squares fits in powers of $\cos\theta$ were made to the available angular distributions. (auth)

41806 RESONANCE MODEL FOR PHOTOPRODUCTION OF K MESONS FROM NUCLEONS. [PART] II. Shigeo Hatsukade (Univ. of Rochester, N. Y. and Pennsylvania State Univ., University Park) and Howard J. Schnitzer. Phys. Rev., 132: 1301-5(Nov. 1, 1963).

Result of numerical calculation based on a formalism of a previous paper is given for the photoproduction of K^+ mesons and Λ hyperons on protons. Partial widths of the second πN resonance and Kπ resonance are adjusted as free parameters. Differential cross section and polarization of Λ hyperon in a reasonable agreement with experiment are obtained in the case when the spin of Kπ resonance is taken to be 1. The ratio of the width for the radiative decay of the $K^* \rightarrow K + \gamma$ relative to the decay mode $K^* \rightarrow K + \pi$ is estimated to be 2.5×10^{-2}. (auth)

41807 SELF-CONSISTENT DEVIATIONS FROM UNITARY SYMMETRY. R. E. Cutkosky and Pekka Tarjanne (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 132: 1354-61(Nov. 1, 1963).

A method of investigating the possible dynamic origin of symmetries among the strong interactions is illustrated by application to a model with vector mesons that are self-consistently bound states of one another. The SU_3 model, with eight vector mesons, is concentrated upon. All possible types of first-order perturbations are treated in the ladder approximation, and some second-order effects are also considered. The results emerging from a qualitative discussion uniquely suggest the possibility (in addition to the degenerate mass solution) of a self-supporting small mass splitting structure of the type leading to the Gell-Mann-Okubo mass formula. Moreover, SU_2 symmetry is necessarily retained, although the differentiation between charge and hypercharge is not possible in a theory that does not include electromagnetism. (auth)

41808 SINGULARITIES OF A RELATIVISTIC SCATTERING AMPLITUDE IN THE COMPLEX ANGULAR MOMENTUM PLANE. K. Bardakci and D. A. Geffen (Univ. of Minnesota, Minneapolis). Phys. Rev., 132: 1361-72 (Nov. 1, 1963).

The analytic properties of the partial-wave amplitude in the complex angular momentum plane are investigated in a relativistic scalar-meson theory. Using a N/D decomposition, the numerator and denominator are calculated by perturbative expansions to fourth order in the coupling constant. Higher order poles at negative integer values of l are found in both the numerator and denominator, leading to a breakdown in their perturbation expansions near these singularities. The same breakdown occurs for all but the leading Regge trajectory. It is further found that, to fourth order, due to inelastic processes, the denominator has branch cuts for values of l near negative integers. (auth)

41809 THEORY OF WEAK INTERACTIONS BETWEEN BARYON AND PION. Seitaro Nakamura (Tokyo Univ. and Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 30: 207-13(Aug. 1963).

For the weak interaction between baryons and pions a new kind of interaction Hamiltonian involving the S, T, and P types with the derivative of the baryon field as well as with that of the pion field is suggested. In order to reproduce the strange nature of the asymmetry factors and the branching ratios for all nonleptonic modes of the hyperon decay in terms of the Yukawa type interactions with a higher symmetry in the extended isotopic spin space, the invariance under the time reversal operation is violated. (auth)

41810 A MODEL OF ELEMENTARY PARTICLES. Seibun Sasaki (Fukui Univ., Japan), Hiroshi Segawa, Hiroshi Yamamoto. Progr. Theoret. Phys. (Kyoto), 30: 214-22 (Aug. 1963).

A model of elementary particles including two neutrinos is proposed where high symmetry between particles is taken into account. To represent this symmetry, a new charge called s-charge is introduced. Using this model and the model of weak interaction proposed previously by one of the authors, the process with $\Delta Q/\Delta S = -1$ can be interpreted satisfactorily. (auth)

41811 DETECTIVE THEORY ON ELEMENTARY PARTICLES. Taizo Muta (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 30: 223-35(Aug. 1963).

A detective method is proposed which may give an answer to the question of how many elementary particles there are in nature. Premising that some kinds of particles are elementary, it is asked whether other particles are elementary or composite. If the off-the-energy-shell T-matrix element for the scattering between elementary particles were known, then an answer would be obtainable by the use of the integral equation given previously by Ezawa et al. The method is illustrated with a field-theoretical-soluble model. (auth)

41812 NOTE ON UNITARY SYMMETRY IN BOOTSTRAP METHOD. Ryuji Kawamura (Tokyo Metropolitan Univ.), Nobuhiko Mishima, and Minoru Monda. Progr. Theoret. Phys. (Kyoto), 30: 268-71(Aug. 1963).

Boson-boson resonances such as ρ, ω, and K^* are discussed. The many strongly interacting particles influence one another to a greater or a lesser degree; the qualitative characteristic features are discussed. (R.E.U.)

41813 THE ISOSINGLET MESON SERIES. Takehiko Takabayasi and Yoshio Ohnuki (Univ. of Nagaya, Japan). Progr. Theoret. Phys. (Kyoto), 30: 272-3(Aug. 1963).

Existence has previously been proven for the isosinglet $\pi^+ - \pi^-$ resonance f and $K - \overline{K}$ resonance φ. The T = Y = O series of mesons η, ω, φ, and f is established from this. The charge-parity relation to spin for these mesons is extended to include any possible self-conjugate bosons. The f-meson is assumed to be the $^3P_2$ state of a tightly bound baryon and antibaryon state. (R.E.U.)

41814 CONCERNING THE BEHAVIOR OF PARTIAL WAVES FOR THE REACTION $\pi\pi \rightarrow \pi\pi$ AT THE THRESHOLD. S. Chulli (Inst. of Atomic Physics, Bucharest). Rev. Phys., Acad. Rep. Populaire Roumaine, 8: 151-6 (1963). (In Russian)

The dispersion relation method that expands the reaction amplitude in a Taylor series in the region where, $-1 < \cos\theta < +1$ was examined. The discussion is limited to the collision of isoscalar mesons (π) so as to avoid the complication brought about by the isotopic spin. The reaction amplitude is expanded as: $A(\nu,t) = \sum_{n=0}^{\infty} A_n w^n$, where $A_n(\nu) = \frac{1}{n!}(\partial^n A/\partial\omega^n)_{\omega=0}$. Lovelace previously examined the asymptotic structure of the solutions of the above equation when ν approaches infinity. Solutions are discussed when ν approaches zero, that is, at the threshold energy. It is shown that for the amplitude $A(\nu,t)$ to behave correctly at the threshold the coefficients $A_i(\nu)$ must remain finite as ν approaches zero. It is then shown that the coefficients $A_i(\nu)$ do indeed remain finite at the threshold. (TTT)

41815 GENERATION OF FAST PARTICLES BY ELECTROMAGNETIC WAVES. Winfried Otto Schumann. Sitzber. Math. Naturw. Kl. Bayer. Akad. Wiss. Muenchen, 1962, 79-84(1963). (In German)

Particles can be accelerated by electrical waves in free space in which magnetic field components were produced which follow the electrical field by about 90°. The conditions and directions of the acceleration were derived. The properties of the phase oscillations are also determined. The significance of damping and wave amplitude decreased with distance from the radiation source was estimated. The conditions derived could be applicable to the acceleration of cosmic particles. (J.S.R.)

41816 MODIFICATION OF THE POLARIZATION OF A BEAM OF DIRAC PARTICLES IN RECIPROCAL EFFECT WITH AN EXTERNAL FIELD. Hans-Joachim Meister. Sitzber. Math. Naturw. Kl. Bayer. Akad. Wiss. Muenchen, 1962, 85-161(1963). (In German)

Interest in the behavior of polarized particles has sharply increased in the last few years as they can be produced easier and are therefore available for use in studies to obtain detailed knowledge on the structure and interaction of elementary particles. From the various descriptions of polarization discussed in the literature, the Michel and Wightman covariant formalism is shown to be especially suitable for the treatment of relativistic scattering problems. This formalism was explained for any particle and then specially represented for particles with spin $\frac{1}{2}$ (Dirac particles) in a form that is used for the study of the behavior of the polarization vector in scattering processes. The study is limited to a consideration of external fields. From the transformation of the density matrix describing the polarization of a particle beam, some general predictions on polarization effects are derived. The behavior of the polarization vector in scattering was explicitly given and discussed for five possible interaction types in the first Born approximation. The scattering in electromagnetic fields of Dirac particles possessing a charge, an abnormal magnetic moment, and an electrical dipole element was investigated in the first Born approximation. With the help of the covariant formalism, the frequency with which the polarization vector of a Dirac wave packet in a macroscopic electromagnetic is precessed is calculated. (tr-auth)

41817 INFLUENCE OF INTERMEDIATE VECTOR BOSON ON BOUND MUON DECAY RATE. L. Palgi. Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 20, 132-7 (1963). (In Russian)

Corrections to the bound muon decay rate due to an intermediate vector boson are estimated. Experimental detection of these corrections is very difficult; at $M_B = 5$ m, $Z = 30$, for example, measurement of $R(30)/R(0)$ with an accuracy of 0.1% is required. (auth)

41818 THE HAMILTONIAN OF MUON CAPTURE VIA INTERMEDIATE VECTOR BOSON. M. Kyiv and L. Palgi. Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 20, 151-3(1963). (In Russian)

A matrix element for μ capture via intermediate vector bosons in G^2 term approximation with weak interaction $(L_i \sim G_j\alpha_\beta)$ was expressed as: $S \sim G^2 \int \bar{u}_\nu(x_1)(1-\gamma_5)i\gamma_\lambda\gamma_5 u_\mu(x_1)D_{\lambda\rho}(x_1-x_2)\cdot\{(n|v_\rho|p) + (n|A_\rho|p)\}e^{i(p-n)x_2}\,dx_1\,dx_2$, where $(n|A_\rho|p) = \bar{u}(n)\{A\gamma_\rho i\gamma_5 - \beta(p-n)_\rho\gamma_5\}u(p)$ and $(n|v_\rho|p) = \bar{u}(n)\{-iC\gamma_\rho - D\sigma_{\rho\beta}(p-n)_\beta\}u(p)$. A, B, C, and D are functions of $(p-n)^2$. Corrections were made for the intermediate boson. (R.V.J.)

41819 RESONANCE INTERACTIONS IN STATISTICAL THEORY OF MULTIPLE PARTICLE PRODUCTION. V. I. Rus'kin. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 3-63(1963). (In Russian)

Statistical theory of multiparticle production was reviewed, and methods for determining resonance particle production are discussed. Experimental data are given on resonance π-π interactions, and their analysis using the periphery interaction theory is discussed. The statistical theory of π-π interactions was used for describing p-$\bar{p}$ annihilation and meson-nucleon interactions. 161 references are included. (R.V.J.)

41820 ON THE DISTRIBUTION OF TRANSVERSE PARTICLE MOMENTA IN NUCLEON-NUCLEON INTERACTIONS. Zh. S. Takibaev, E. G. Boos, and N. P. Pavlova. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 90-3(1963). (In Russian)

Angular distribution of elastic nucleon scattering and correlation to the optical model were studied previously. An attempt was made to determine the distribution of

elastically scattered particles by their transverse momenta and to compare the data with inelastic processes. A histogram was constructed for transverse momenta in proton elastic scattering at 0.8 and 8.7 Bev and compared with transverse momenta in inelastic interactions at 9 Bev. The comparison showed that the interaction was not a function of interacting nucleon energy, but coincided with elastic and inelastic processes. The stability of secondary particle transverse momentum distribution was used for approximation calculations of multiple meson production parameters (Lorentz factor of inelastic scattering nucleons and angular distribution in center-of-mass system). The method was based on the assumption that particle emission angles do not depend on particle momenta. A histogram of the total angular distribution of cosmic shower particles at E > 10^{11} ev was constructed and analyzed. (R.V.J.)

41821 TWO-PRONG STARS FORMED IN INELASTIC p-p INTERACTIONS AT 9 Bev. Zh. S. Takibaev, I. Ya. Chasnikov, Ts. I. Shakhova, and Z. V. Anzon. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 94-100(1963). (In Russian)

Angular and energy distributions for secondary protons and π mesons were found, and various reactions and their cross sections are analyzed. (tr-auth)

41822 ON CRITERIA IN SELECTIONS OF P-N INTERACTIONS. E. G. Boos and G. Ya. Grigor'eva. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 140-3(1963). (In Russian)

An additional criterion (a θ angle limitation) was introduced that facilitated the separation of nucleon and quasi-nucleon interactions in analyzing nucleon-proton interactions in emulsions and identifying secondary particles of ~10 Bev. (R.V.J.)

41823 INELASTIC π-N INTERACTIONS AT 7.5 Bev. A. Kh. Vinitskii, I. G. Golyak, N. P. Pavlova, V. I. Rus'kin, and Zh. S. Takibaev. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 144-59(1963). (In Russian)

Studies of inelastic π^--N interactions in irradiated emulsion revealed 2100 events. The distribution of 200 events was calculated by statistical theory considering isobars. The results showed that only a certain percent of events with various multiplicities coincided with published data and statistical theory. Angular π-meson distribution in the center-of-mass system was asymmetric, but the asymmetry diminished with the multiplicity. Proton angular distributions were also asymmetric, but their asymmetry did not depend on multiplicity. Proton and π meson momentum distributions have two maxima each. Short prong momentum and angular characteristics are described by kinematic analysis. The results indicated the importance of processes taking place during π-π resonance and nucleon isobar formation. (R.V.J.)

41824 OBSERVATION OF $K_2^0 \rightarrow \pi^+ + \pi^- + \pi^0$ DECAYS. M. Kh. Anikina, O. N. Gogitidze, M. S. Zhuravleva, et al. (Joint Inst. for Nuclear Research, Dubna, USSR and Inst. of Physics, Academy of Sciences, Georgian SSR). Zh. Eksperim. i Teor. Fiz., 45: 469-73(Sept. 1963). (In Russian)

Four decays of long lived K^0-mesons with concomitant emission of four charged particles were observed in a cloud chamber bombarded by a neutral particle beam from the JINR synchrophasotron. All four events are identified as decays. An estimation of the decay probability of $K_2^0 \rightarrow \pi^+ + \pi^- + \pi^0$ relative to all K_2^0-decays involving secondary particles yields 0.08 ± 0.04. (auth)

41825 MEASUREMENT OF THE SPIN CORRELATION COEFFICIENT IN ELASTIC pp-SCATTERING AT 315 Mev. I. M. Vasilevskii, V. V. Vishnyakov, E. Ilieşku, and A. A. Tyapkin (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 474-9(Sept. 1963). (In Russian)

The experimental procedure is described and results of measurement of the spin correlation coefficient (C_{nn} = 0.76 ± 0.15) are presented for 315-Mev protons elastically scattered on protons at an angle of 90° (in the cms). (auth)

41826 REGGE POLES AND THE ASYMPTOTIC BEHAVIOR OF THE CROSS SECTIONS OF SOME WEAK INTERACTION PROCESSES. Nguyen Van Hieu (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 544-7(Sept. 1963). (In Russian)

The asymptotic behavior of the cross sections for weak interaction inelastic processes are examined under the assumption of the existence of Regge poles with $\alpha(0) = 1$. (auth)

41827 RESTRICTIONS OF THE COUPLING CONSTANTS AND VERTEX PART OF THREE-PARTICLE INTERACTION IN QUANTUM FIELD THEORY. [PART] II. B. V. Geshkenbein and B. L. Ioffe (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 555-64(Sept. 1963). (In Russian)

It is shown that rejection of the assumption made previously for the fermion case regarding the absence of zero in the fermion Green function does not affect the conclusion about restriction on the coupling constant. It is demonstrated that under the same assumptions the vertex part of $\Gamma(x^2)$ is restricted by the inequality $\Gamma_{min}(x^2) \leq \Gamma(x^2) \leq \Gamma_{max}(x^2)$. Explicit expressions are obtained for functions $\Gamma_{min}(x^2)$ and $\Gamma_{max}(x^2)$. The expressions depend on the value of the renormalized coupling constant g^2. (auth)

41828 POLARIZATION PHENOMENA IN SCATTERING OF π-MESONS ON NUCLEONS AND THE FERMION REGGE POLES. M. P. Rekalo (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 45: 595-8(Sept. 1963). (In Russian)

Polarization phenomena in meson-nucleon scattering are studied for high energies and scattering angles ~180°. It is shown that the recoil nucleon polarization does not oscillate at asymptotically high energies. Only correlative quantities oscillate. The magnitude of the oscillation amplitude is estimated. (auth)

41829 REAL PART OF THE AMPLITUDE FOR ELASTIC pp FORWARD SCATTERING. L. S. Azhgirei and S. B. Nurushev (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 599-603(Sept. 1963). (In Russian)

The real part of the spinless amplitude for pp forward scattering is determined from results on Coulomb scattering of protons on protons in the 150–660 Mev energy range. The results are compared with those obtained from phase shift analysis and from dispersion relations. (auth)

41830 CONTRIBUTION TO THE THEORY OF SPIRAL AMPLITUDES. Ya. A. Smorodinskii (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 604-9(Sept. 1963). (In Russian)

Calculations with spiral amplitudes introduced by Wick and Jacob become almost trivial when using the graphical method of relativistic velocity space with a Lobachevsky metric. The relativistic properties of the spiral amplitudes are more apparent in this space. As an example the problem of transforming spin amplitudes from one binary re-

action channel to another is considered (cross-transformation of field theory). (auth)

41831 THE HYPOTHESIS OF REGGE POLES IN QUANTUM FIELD THEORY AND THRESHOLD FEATURES OF INELASTIC PROCESSES. L. A. Khalfin (Inst. of Mathematics, Leningrad). Zh. Eksperim. i Teor. Fiz., 45: 631-6(Sept. 1963). (In Russian)

The agreement between the hypothesis of Regge poles in quantum field theory and the threshold features of inelastic processes in the s-channel (but not the t-channel) is investigated. Additional information concerning the asymptotic behavior of inelastic processes is obtained on basis of the Regge poles hypothesis. (auth)

41832 COMPARISON OF ELASTIC πp AND pp-SCATTERING ON BASIS OF THE THREE REGGE POLE MODEL. V. P. Kanavets, I. I. Levintov, and B. V. Morozov (Inst. of Experimental and Theoretical Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 679-83(Sept. 1963). (In Russian)

An attempt is made to correlate the data on $\pi^{\pm}$p-scattering with the pp and $\bar{p}p$-scattering data by invoking the three pole model suggested by Rarita et al. It is shown that the model in which $\pi^{\pm}$p scattering is described by P, P' and ρ poles and pp- and $\bar{p}p$-scattering by P, P' and ω poles leads to qualitative disagreement with the experiments that apparently do not yield any narrowing of the diffraction cone in the π^{-}p-system for $3.4 \leq s/M^2 \leq 30$ and $|t| \leq 0.4(\text{Bev/c})^2$. In order to interpret the results of Ting et al. on the basis of the Regge pole theory, additional poles should be introduced for which the trajectories possess a negative slope at $t < 0$. (auth)

41833 ON THE THEORY OF NEUTRAL VECTOR FIELD OF SPIN 1. V. I. Ogievetskii and I. V. Polubarinov (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 709-12(Sept. 1963). (In Russian)

The most general form for the interaction between a neutral spin 1 vector field and spinor field is derived. Such interactions are necessarily found to be invariant with respect to certain phase transformations. (auth)

41834 RADIATIVE CAPTURE OF μ^{-}-MESONS IN HYDROGEN. G. A. Lobov (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 713-22(Sept. 1963). (In Russian)

Mesic atomic and mesic molecular effects during radiative capture of μ^{-}-mesons in hydrogen ($\mu^{-} + p \rightarrow n + \nu + \gamma$) are considered. Expressions for the spectrum and degree of photon circular polarization are obtained by taking into account all terms whose contribution to the amplitude of the $\mu^{-} + p \rightarrow n + \nu + \gamma$ process is of the order of m_μ/m and $(m_\mu/m)^2$(m_μ and m are respectively the μ^{-}-meson and nucleon masses). Curves representing the spectrum and the degree of photon circular polarization for the $\mu^{-} + p \rightarrow n + \nu + \gamma$ process as a function of photon energy are presented for various values of the effective pseudoscalar interaction constant C_P. It is shown that the probability for radiative capture of μ^{-}-mesons in hydrogen strongly depends on the ratio $\varkappa = C_P/8C_A$ (C_A is the axial-vector weak interaction constant). Thus, for example, the probability for radiative capture of a μ^{-}-meson from a hyperfine structure state in mesic hydrogen with a total spin F = 0 grows faster than $\varkappa^2$ with increase of $\varkappa$. (auth)

41835 ON FACTORIZATION OF THE SCATTERING AMPLITUDES OF PARTICLES WITH SPINS AT THE REGGE POLE. D. V. Volkov. Zh. Eksperim. i Teor. Fiz., 45: 742-5(Sept. 1963). (In Russian)

It is demonstrated that by employing derivatives with respect to particle momenta, the contribution of the Regge boson pole to the scattering amplitude of particles with a spin can be represented in an explicitly factorized form. (auth)

41836 INVESTIGATION OF THE S-MATRIX IN COMPLEX ANGULAR MOMENTUM SPACE IN THE QUASI-CLASSICAL CASE. A. Z. Patashinskii, V. L. Pokrovskii, and I. M. Khalatnikov (Inst. of Thermal Physics, Academy of Sciences, Siberian SSR; Inst. of Radiophysics and Electronics, Academy of Sciences, Siberian SSR; and Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 760-71(Sept. 1963). (In Russian)

An efficient method is developed for investigating the scattering matrix S(v) in complex space of angular momenta $l = \nu - \frac{1}{2}$. The analysis is carried out in nonrelativistic quantum mechanics. The method is based on a study of the properties of quasi-classical solutions of the radial Schroedinger equation in the complex radius-vector plane. (auth)

41837 ON RESONANCE REFLECTION OF γ-RAYS FROM THE SURFACE OF A CRYSTAL. M. I. Podgoretskii (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 780-2(Sept. 1963). (In Russian)

The time dependence of the intensity of resonance γ rays reflected from the surface of a crystal is investigated. It is shown that if the resonance frequencies of the emitter and reflector are different, the intensity of the reflected waves is subjected to beats. Interference between resonance nuclear scattering and Rayleigh scattering on atomic electrons is considered. Interference disappears if the resonance frequencies of the emitter and reflector are the same. (auth)

41838 SOME CONSEQUENCES OF THE LONG LIFETIME OF η- AND ω-MESONS. V. G. Grishin and M. I. Podgoretskii (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 45: 783-6(Sept. 1963). (In Russian)

A possibility of experimentally verifying the law of conservation of isotopic spin in strong interactions by studying η and ω decays is considered. Estimations indicate that isotopic invariance is valid with an accuracy to within 10^{-4}. On the basis of the long lifetime of η and ω mesons it is concluded that some hypothetical mesons in reality do not exist. (auth)

41839 ANALYTICAL PROPERTIES OF THE FORWARD SCATTERING AMPLITUDE IN NONLOCAL THEORY. L. V. Prokhorov (Leningrad State Univ.) Zh. Eksperim. i Teor. Fiz., 45: 791-6(Sept. 1963). (In Russian)

Analyticity of the forward scattering amplitude is proven in nonlocal theory under the assumption that the field commutator decreases sufficiently rapidly in the space-like direction. Conditions under which complex singularities appear are indicated. (auth)

41840 DEPOLARIZATION OF RELATIVISTIC ELECTRONS IN A MAGNETIC FIELD. S. S. Sannikov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 45: 797-9(Sept. 1963). (In Russian)

The normal (Bohr) and anomalous (Pauli) parts of the magnetic moment of an electron moving in a magnetic field with an energy $\epsilon - m \ll m$ (m is the electron mass) kinematically behave the same. The expressions for the rotation frequency of the electron spin ω_s in the energy range $\epsilon - m \sim m$ indicate that there is a strong difference in the kinematical properties of the normal and anomalous

parts of the electron magnetic moment in this energy region. It is shown that in the limiting case of high energies $\epsilon \gg m$ the normal and anomalous parts of the magnetic moment do not differ kinematically. Thus the correspondence characteristic for low energies is restored. (auth)

41841 REGGE POLES IN THE NONRELATIVISTIC PROBLEM WITH LOCAL AND SINGULAR INTERACTION. V. G. Vaks and A. I. Larkin (Inst. of Atomic Energy, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 800-9(Sept. 1963). (In Russian)

Singularities of the amplitude in the l-plane are studied with aid of the Schroedinger equation in the momentum representation. The relation between the analytical properties of the amplitude and the behavior of the potential at small distances is elucidated. It is shown that nonlocality of the potential leads to pole condensation or branching at $l = -1$. (auth)

41842 PHOTOPRODUCTION OF π-MESONS ON NUCLEONS AND FERMION REGGE POLES. M. P. Rekalo, V. G. Gorshkov, and G. V. Frolov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR and Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 45: 672-8(Sept. 1963). (In Russian)

The asymptotic behavior of π meson photoproduction on nucleons at high energies and π meson angles of formation ~180° is investigated under the assumption of existence of moving poles in the partial amplitudes. Asymptotic values of the differential cross section and polarization of recoil nucleons are derived. Assuming unitarity in the u-channel, it is shown that in the limit of high energies and scattering angles close to ~180° relation holds for the differential cross sections. (auth)

41843 PROPERTIES OF THE ω MESON. J. B. Shafer, J. J. Murray, M. Ferro-Luzzi, and D. O. Huwe. 4p. (CONF-122-13)

From International Conference on Nucleon Structure, Stanford, Calif., June 1963.

Properties of the ω meson were studied from the reaction $K^- + p \rightarrow \Lambda + \omega$ in a 72-in. hydrogen bubble chamber. The momentum of the K^- mesons was 1.2 to 1.75 Bev/c. The mass of the ω meson is found to be 782 Mev with a width, predominated by three-meson(π) decay mode, estimated to be less than 4 Mev. Branching ratios for ω-meson decay into $\pi^+\pi^-\pi^0$, $\pi^0\gamma$, $\pi^+\pi^-$, and e^+e^- were determined. (R.E.U.)

Neutron Physics

Refer also to abstracts 41124, 41132, 41133, and 41134.

41844 (GA-4265) GAM-II. A B_3 CODE FOR THE CALCULATION OF FAST-NEUTRON SPECTRA AND ASSOCIATED MULTIGROUP CONSTANTS. G. D. Joanou and J. S. Dudek (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Sept. 16, 1963. 92p.

GAM-II, a consistent B_3 program for the calculation of fast neutron spectra and associated multigroup constants, is described. Among its features are: the inclusion of 99 energy groups (0.414 ev to 14.9 Mev); provision for slowing-down flux calculations in the B_1, B_2, B_3, or P_1 approximations; updating routines for the data tape; inclusion of P_0, P_1, P_2, and P_3 scattering kernels on the data tapes, and the option of calculating the plane moments of the slowing-down kernel. The mathematical bases, input instructions, sample input and output, library listing, and fission sources are included. (D.C.W.)

41845 (AEC-tr-6092) PROPAGATION OF FISSION NEUTRONS IN GRAPHITE AND SODIUM. COMPARISON OF CALCULATION AND EXPERIMENT IN THE NAIADE SETUP. F. Le Berre and P. Pepin (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Translated for Oak Ridge National Lab., Tenn., from report DEP/SEPP-196/62. Jan. 1962. 19p.

A formula was developed for the slowing-down density within the framework of age theory for a moderator medium in the form of a parallelepiped. A plane disk fission neutron source on a side of the medium was considered. Leaks on the sides were taken into account. Experimentally, the attenuation law in sodium and graphite was found to be $\exp(-X^2/4\tau)$. The ratio of the calculated fluxes to the measured fluxes in sodium and graphite were 1.45:1 and 1.61:1, respectively. (D.C.W.)

41846 (AEC-tr-6094) THE TRANSPORT THEORY IN A HEAVY MEDIUM. H. G. Kaper (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Translated for Oak Ridge National Lab., Tenn., from report DEP/SEPP-213/62. Mar. 1962. 17p.

The transport equation for a homogeneous elastic medium with a plane, isotropic source is given, and the series approximation in 1/A for a heavy moderator medium is derived. Solutions for the heavy medium in the $1/A^3$, $1/A^2$, and 1/A approximations are obtained. (D.C.W.)

41847 (AEC-tr-6095) ATTENUATION OF NEUTRONS OF NAIADE IN A GRAPHITE BLOCK—CALCULATION OF THE THERMAL FLUX BY THE TWO-GROUP DIFFUSION THEORY. J. Brisbois (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Translated for Oak Ridge National Lab., Tenn., from report DEP/SEPP-199/62. Jan. 1962. 15p.

Thermal fluxes in a graphite block were calculated for a fission source and a thermal source using two-group and one-group diffusion theory, respectively. The 30% deviation from the experimental value, observed in the thermal source case, is satisfactory considering the possible errors. A deviation by a factor of about 2 was observed for the fission source. Similarity of the results to those for a two-group theory in an infinite medium shows that the side dimensions have little effect. (D.C.W.)

41848 THE TEMPERATURE DEPENDENCE OF EFFECTIVE RESONANCE INTEGRALS. A. Reichel (Univ. of Sydney). J. Nucl. Energy, Pts. A & B, 17: 281-92(Sept. 1963). (In English)

Algebraic approximations to the function $J(\xi,\beta)$ are derived to investigate temperature behavior of the effective resonance integrals of resonances of different energy. Temperature dependences between $T^{-\frac{1}{2}}$ for high-energy resonances and T^{+1} for low-energy resonances are shown to exist. The effect on the overall temperature behavior of effective resonance integrals is discussed. (auth)

41849 ABSOLUTE CALIBRATION OF THE NATIONAL BUREAU OF STANDARDS PHOTONEUTRON SOURCE. III. ABSORPTION IN A HEAVY WATER SOLUTION OF MANGANOUS SULPHATE. R. H. Noyce, E. R. Mosburg, Jr., S. B. Garfinkel, and R. S. Caswell (National Bureau of Standards, Washington, D. C.). J. Nucl. Energy Pts. A & B, 17: 313-19(Sept. 1963). (In English)

The neutron emission rate for the National Bureau of Standards radium–beryllium (γ,n) standard source (NBS-I) was redetermined by a relative comparison to an antimony–beryllium source, which had been calibrated absolutely in a heavy water manganous sulfate solution through an indirect

method involving $4\pi\ \beta-\gamma$ coincidence counting of the induced Mn^{56} activity. Correction was made for absorption of neutrons by other elements present in the bath. The emission rate of NBS-I was found to be 1.25×10^6 n/sec as of June, 1961 with an uncertainty of 1%. This measurement, when suitably averaged with previous determinations yields the best value 1.25×10^6 n/sec with an uncertainty of 1%. (auth)

41850 PRODUCTION AND STUDY OF MONOCHROMATIC POLARIZED BEAMS OF SLOW NEUTRONS. H. Beil, P. Carlos, and J. Matuszek. J. Phys., 24: 359-66 (June 1963). (In French)

Results are described that are obtained with a neutron spectrometer producing monochromatic polarized neutron beams in the energy range 10^{-3} to 10 ev, using a series of artificial 92% Co–Fe monocrystals as polarizers and analyzers. A description of the installation itself, some preliminary results obtained with Fe_3O_4 crystals, and experimental results pertaining to various magnetic guide and "spin flip" systems as required in the handling of such polarized neutron beams are given. (auth)

41851 REFLECTION CORRECTION FOR THERMAL NEUTRON SPECTRA DERIVED FROM TRANSMISSION DATA. E. A. Burke and L. F. Lowe (Air Force Cambridge Research Labs., Bedford, Mass.). Nucl. Instr. Methods, 24: 131-2(July 1963). (In English)

It is noted that a thermal neutron spectrum can be reconstructed from transmission data by the use of an appropriate Laplace transform. Spectra obtained in this manner, however, show a shift toward lower-neutron energies. This shift is shown to be attributable to the mirror reflection of neutrons from the walls of the collimator tube. Application of the mirror-reflection correction to the Laplace-transform result yields a Maxwellian-like spectrum that agrees with the experimentally observed spectrum. The neutron temperature calculated using the reflection correction agrees within 3% with the temperature calculated from the moderator temperature in the reactor used as the neutron source. (T.F.H.)

41852 NUMERICAL SOLUTION OF THE NEUTRON TRANSPORT EQUATION. Reimar Froehlich. Nukleonik, 5: 249-56(Sept. 1963). (In German)

The solution of the monoenergetic neutron transport equation of Boltzmann was reduced in the case of isotropic scattering and plane geometry to the solution of an integral equation. By use of the "Galerkinsche" method on this integral equation a simple and efficient numerical process was developed. With the help of some values for the solution of the neutron transport equation, in dependence on the inhomogeneity (source) and the remaining physical constants, an important class of error values was derived from the "Galerkinsche" approximation solution. From these values the existence and clearness of a solution to the neutron transport equation as well as a convergence proof for the "Galerkinsche" process were demonstrated. The "Galerkinsche" method was compared in some examples with other numerical processes. (tr-auth)

41853 INVESTIGATION OF THE NEUTRON-SCATTERING CROSS SECTIONS OF HEAVY ICE IN THE REGION OF THE BRAGG THRESHOLD WAVELENGTH. Wolfram Gissler (Technische Hochschule, Munich). Z. Krist., 118: 149-57(May 1963). (In German)

The neutron-scattering cross sections σ, of heavy ice at 4 and 77°K were measured by transmission experiments as a function of neutron-wave length in the range $5 < \lambda < 50$ Å. Above the Bragg cutoff $\lambda_{Bragg} = 2d_{max} \approx 8$ Å (d_{max} is the maximum possible distance between the lattice planes) σ_s, contains two parts: σ_{spin} from the deuteron spin, and a small contribution, σ_{un}, from an eventual deuteron-orientation disorder in the lattice. The values for σ_{un} was approximately calculated according to the statistical ice model of Pauling in an approximation better than that described previously. It was found that σ_{un} is smaller than 10^{-2} barns for $\lambda > 10$ Å. The experimental accuracy is not sufficient to determine this contribution of disorder. Under these circumstances the spin incoherent-scattering cross section, σ_{spin}, could be determined with an accuracy better than that of present values. It was found for deuterium that $\sigma_{spin} = 2.25 \pm 0.04$ barns. Alcock and Hurst found that $\sigma_{spin} = 2.0 \pm 0.13$ barns. Shull and Wollan that $\sigma_{spin} = 2.5 \pm 0.5$ barns (as difference between total and coherent cross section). After measuring the inelastic-scattering cross section at 77°K the effective Debye-Temperature of D_2O ice was determined as: $\Theta_{eff} = 228° \pm 5°K$. This can be compared with $\Theta = 237°K$ from Zajak and $\Theta_{eff} = 220° \pm 10°K$ from deuteron amplitudes in D_2O ice measured by Peterson and Levy. (auth)

41854 THE REFLECTION ABILITY OF MOSAIC CRYSTALS IN REGARD TO THEIR USE AS MONOCHROMATORS IN NEUTRON DIFFRACTION SPECTROMETERS. Hermann Stehr (Universität, Munich). Z. Krist., 118: 263-72(June 1963). (In German)

A calculation was made of the integral reflectivity of ideal mosaic crystals according to the theory of mosaic structures. Both the reflection and transmission patterns were derived for different values of the Bragg angles θ_0 used for monochromatization, from the reduction in beam cross section according to the Fankuchen cut, from the effective total cross section of the monochromator material, and from the thickness of the crystal. The influence of the latter on the change in beam cross section was estimated. An intensity formula is proposed for the problem of image formation that arises in connection with the examination of small test crystals. Some measurements on real crystals were carried out. (auth)

Nuclear Properties and Reactions

Refer also to abstracts 40432, 40434, 40435, 40436, 40437, 41125, 41287, and 41289.

41855 (AFCRL-62-162) A SHORT SURVEY OF RECENT NUCLEAR REACTION EXPERIMENTS EMPLOYING 1-3 Mev PARTICLE ACCELERATORS. E. F. Kennedy (Air Force Cambridge Research Labs., Laurence G. Hanscom Field, Bedford, Mass.). June 1962. 35p. (AD-2899528)

The nuclear physics experiments that were performed recently, using particle accelerators similar to the 3-Mev positive or negative polarity Van de Graaff accelerator at the Air Force Cambridge Research Laboratories are surveyed. 172 references. (auth)

41856 (CEA-2296) INTERET DE L'UTILISATION DE LA DROITE DE HENRY EN SPECTROMETRIE γ. (The Advantage of Using the Henry Straight Line in γ Spectrometry). Jockey (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 13p.

The Henry construction permits interpretation of the total absorption peaks in gamma spectrometry without laborious calculations by exploiting their statistical significance. The resolution, position of the peak, etc., can be determined accurately and graphically. The principals and main applications of the method are described. (auth)

41857 (CONF-22-27) THE $F^{19}(p,t)$ AND $F^{19}(p,\alpha)O^{16}$ REACTION. H. D. Holmgren (Maryland. Univ., College Park) and C. B. Fulmer (Oak Ridge National Lab., Tenn.). [1963]. Contract W-7405-eng-26. 22p.

From American Physical Society, 1963 Annual Meeting, New York, Jan. 1963.

The differential cross sections for the $F^{19}(p,t)F^{17}$ reactions leading to the ground state and first-excited state of F^{17}, and for the ground-state α-particle group and the composite α-particle groups corresponding to the two unresolved doublets at 6 Mev (6.05 and 6.13) and at 7 Mev (6.92 and 7.12) of excitation in O^{16} from the $F^{19}(p,\alpha)O^{16}$ reaction were measured as functions of angle at an incident energy of 22.8 Mev. Data were also obtained for higher excited-state groups from both reactions at several forward angles. The angular distributions for all groups exhibit typical oscillatory variations with angles, to the largest angles observed, 170°. The amplitude of the variations is most pronounced for the α_0 group. The total cross sections, obtained by numerical integration of the differential cross sections, are 1.84, 1.45, 0.53, 0.43, and 0.45 mb for the t_0, $t_{0.5}$, α_0, α_6 and α_7 groups, respectively. The angular distributions of the t_0, $t_{0.5}$, and α_0 groups were fitted with DWBA calculations. Exchange interactions do not appear to be required in order to fit these data, although the possibility of knockout processes cannot be eliminated on the basis of the present calculations. (auth)

41858 (CONF-46-99) NUCLEAR ANOMALOUS DISPERSION IN Fe^{57} BY THE METHOD OF TOTAL REFLECTION. S. Bernstein and E. C. Campbell (Oak Ridge National Lab., Tenn.). [1962]. Contract [W-7405-eng-26]. 32p.

From American Physical Society 1963 Spring Meeting, Washington, D. C., Apr. 1963.

The recoil-free coherent resonant scattering of the 14.4-kev Fe^{57} gamma rays has been investigated by employing the techniques of the Mössbauer effect and those of total reflection. Of particular interest are the observed large interference effects attributed to the coherent superposition of the several resonant nuclear contributions and the nonresonant electronic contribution to the scattering amplitude in the forward direction. Gamma rays from a 300 millicurie Co^{57} source, diffused into the thin edge of a stainless steel plate, were reflected at small glancing angle θ by an optically-flat Fe^{57} mirror through a narrow slit into a NaI scintillation detector. The resonant frequency spectrum of the Fe^{57} nuclei in the mirror was scanned by varying the source velocity, v. Values of the absolute reflectivity $R(\theta,v)$ were obtained by comparison of the direct and reflected measured intensities. In an auxiliary experiment R(v) was measured with an external field applied to the mirror. The results of these measurements were compared with computer-programmed calculations based on the classical optical theory of total reflection. Appropriately averaged quantum-mechanical expressions were introduced for the coherent resonant nuclear scattering amplitude in the forward direction. Separate computations were made for each polarization state of the incident radiation; these were averaged to give $R(\theta,v)$ appropriate for an unpolarized source and a polarization-insensitive detector. Suitable integrations were performed to take into account the frequency spread and angular width of the incident radiation. For $\theta = 4$ milliradians, R(v), computed with the six resonances of normal ferromagnetic Fe^{57}, agreed in shape and magnitude with the observed reflectivity, when the resonance width was assumed to be four times the natural width. For $\theta = 2$ milliradians, where the gamma ray penetration depth is small, anomalies in the magnetic and chemical environment of the Fe^{57} nuclei near the mirror surface required the introduction of additional resonances for FeO and for non-magnetic Fe. (auth)

41859 (CONF-62-15) PRECISION MEASUREMENTS OF EXCITATION FUNCTIONS FOR THE COULOMB EXCITATION OF THE 2^+ AND 4^+ ROTATIONAL LEVELS IN Sm^{152}. J. de Boer, G. Goldring, and H. Winkler (California Inst. of Tech., Pasadena). [1963]. Contract [AT(04-3)-383]. 21p.

From 3rd Conference on Reactions Between Complex Nuclei, Asilomar, Calif., Apr. 1963.

The probabilities of exciting the 2^+ and 4^+ rotational states in Sm^{152} were determined for backscattered oxygen ions with energies of 18 to 42 Mev. The results are compared with the Coulomb excitation theory of lowest significant order and with the multiple excitation theory. The agreement with the Coulomb theory is good for both 2^+ and 4^+ states at low energies. The purity of the Coulomb excitation process was checked. (D.L.C.)

41860 (HW-75716(Vol.1)) UPDATED R.B.U. BASIC LIBRARY. VOLUME 1. Records: 1-309, Isotopes: H^1-Mo^{96}. R. C. Liikala (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 20, 1963. Contract AT(45-1)-1350. 369p.

The revised Hanford library of cross sections, resonance parameters, inelastic spectra, and nuclear descendents (product nuclei) for neutron reactions and scattering with isotopes H^1 through Mo^{96} is presented. (D.C.W.)

41861 (HW-75716(Vol.2)) UPDATED R.B.U. BASIC LIBRARY. VOLUME 2. Records: 310-664, Isotopes: $Mo^{97}-Au^{200}$. R. C. Liikala (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 20, 1963. Contract AT(45-1)-1350. 396p.

The revised Hanford library of cross sections, resonance parameters, inelastic spectra, and nuclear descendents (product nuclei) for neutron reactions and scattering with isotopes Mo^{97} through Au^{200} is presented. (D.C.W.)

41862 (HW-75716(Vol.3)) UPDATED R.B.U. BASIC LIBRARY. VOLUME 3. Records: 665-904, Isotopes: $Hg^{196}-Pu^{240}$. R. C. Liikala (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 20, 1963. Contract [AT(45-1)-1350]. 390p.

The revised Hanford library of cross sections, resonance parameters, inelastic spectra, and nuclear descendents (product nuclei) for neutron reactions and scattering with isotopes Hg^{196} through Pu^{240} is presented. (D.C.W.)

41863 (INSJ-60) NUMERICAL DIFFERENTIAL CROSS SECTIONS OF THE SCATTERING OF ALPHA PARTICLES. III. C^{12}. [PART] I. I. Nonaka, T. Mikumo, H. Yamaguchi, M. Odera, Y. Hashimoto, M. Kondo, and T. Maki (Tokyo Univ. Inst. for Nuclear Study). Aug. 23, 1963. 10p.

Elastic and inelastic (Q = −4.43, −7.656, and −9.63 Mev) cross sections for alpha particle scattering at 28.4 to 33.6 Mev on carbon-12 (carbon foil, 2.38 mg/cm^2 in thickness) are tabulated. (D.C.W.)

41864 (INSJ-61) NUMERICAL DIFFERENTIAL CROSS SECTIONS OF THE SCATTERING OF ALPHA PARTICLES. IV. C^{12}. [PART] II. I. Nonaka, T. MiKumo, H. Yamaguchi, S. Hitaka, T. Maki, T. Nakashima, and M. Mukae (Tokyo Univ. Inst. for Nuclear Study). Aug. 23, 1963. 25p.

Elastic and inelastic cross sections for the scattering of alpha particles at 27 to 35.5 Mev on carbon-12 (natural carbon foil, 2.38 mg/cm^2 in thickness) are tabulated. (D.C.W.)

41865 (IS-607) LEAST STRUCTURE SOLUTION OF PHOTONUCLEAR YIELD FUNCTIONS. B. C. Cook (Ames Lab., Ames, Iowa). [Mar. 6, 1963]. Contract W-7405-eng-82. 40p.

A method (least structure analysis) for the solution of experimental photonuclear yield functions for cross sections is presented. The method gives the "smoothest" set of cross sections as a function of photon energy consistent with the experimental yield. Cross sections derived by least structure analysis of trial yield functions are presented. The resulting cross sections are compared to the assumed cross sections used to derive the trial yield function. This comparison fully justifies the use of least structure analysis at all energies including energies higher than the giant resonance energy where other methods have failed to give physically acceptable solutions. Errors and resolution functions corresponding to the least structure solution of the trial yields are also given. (auth)

41866 (NAA-SR-Memo-8904) PRELIMINARY GRAPHICAL DISPLAYS OF THE NEUTRON CROSS SECTION MASTER TAPE. H. Alter and H. J. Lorenzi (Atomic International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1963. Contract AT(11-1)-Gen-8. 231p.

CRT plots of the data contained on the master tape of neutron microscopic cross sections are presented. Listings of this data, by element or by cross section per element, are available upon request. (auth)

41867 (NP-13156) RENDIMIENTO DE U^{237} EN LA IRRADICION DE URANIO CON DEUTERONES. Informe No. 88. (Yield of U^{237} From the Irradiation of Uranium with Deuterons). Report No. 88. M. Rudelli and G. A. Dupetit (Argentina. Comisión Nacional de Energía Atómica, Buenos Aires). 1963. 8p.

The yield of U^{237} with 26.7 Mev deuterons on metallic natural uranium foils (104 mg/cm^2) was measured. The reaction $Al^{27}(d,\alpha p)Na^{24}$ was used as beam monitor, the charge input being calculated from Na^{24} cross section values given by Lenk and Slobodrian. Absolute beta activities due to Na^{24} and U^{237} were measured in a 4π proportional counter. Radiochemical purity of U^{237} was established from half life and gamma spectrometry measurements. The yield of U^{237} was found to be 9.7 ± 1.4 μcuries/μamp-hr. (auth)

41868 (TID-18080) MONTE CARLO ANALYSIS OF TIME-OF-FLIGHT SCATTERING EXPERIMENTS. M. H. Waechter, J. Weber, and L. E. Beghian (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [Mar. 6, 1963]. Contract AT(30-1)-2098. 28p.

Time-of-flight spectra of single and multiple scattered neutrons are calculated with the Monte Carlo method and are compared with experimental data on scattering from oxygen and CD_4 (polarization measurements). These calculations are used to compute a time-dependent multiple scattering correction. It is important in such analyses to include the specific features of the experiment to be studied, such as exact scatterer geometry, temporal source distribution, or detector characteristics. The technique is not limited to neutron scattering. (auth)

41869 (TID-18173) AN ABSOLUTE ION VELOCITY GAUGE AND DETERMINATION OF NUCLEAR STANDARDS. B. R. Gasten (Wisconsin. Univ., Madison). [1962]. Contract AT(11-1)-Gen-7. 31p.

A time-of-flight technique was used to find the $Li^7(p,n)Be^7$ threshold energy and an $Al^{27}(p,\gamma)Si^{28}$ resonant energy. Results place the $Li^7(p,n)$ threshold at 1879.8 ± 0.6 kev and the $Al^{27}(p,\gamma)$ resonance at 991.6 ± 0.2 kev. The lithium threshold was determined by use of a (yield)$^{3/2}$ extrapolation. The aluminum resonant energy is taken as the half-height energy of a thick target yield. The proton beam was modulated at approximately 50 Mc by use of an Einzel lens at the ion source of an electrostatic accelerator. The lens was driven by a 25 Mc crystal controlled oscillator-amplifier. The time-of-flight equipment consisted of a drift tube of adjustable length centering about 240 cm, a "phase meter" employing a variable delay line which was varied up to 2 nsec, and two pickups consisting of tuned cylindrical tubes 9.8 cm long through which the proton beam passed. Frequency was measured by zero beating a variable frequency crystal oscillator against the signal picked off the beam and counting the crystal frequency with a frequency counter standardized to WWV. The lithium and aluminum targets were protected from organic vapors by a concentric liquid nitrogen trap. (auth)

41870 (UCRL-7211) ALPHA DECAY OF NEUTRON-DEFICIENT ASTATINE ISOTOPES. R. W. Hoff, F. Asaro, and I. Perlman (California. Univ., Livermore. Lawrence Radiation Lab. and California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 31, 1963. Contract W-7405-eng-48. 35p.

The alpha particle and gamma ray spectra of neutron-deficient isotopes of astatine were studied with a magnetic alpha-particle spectrograph and alpha-gamma coincidence apparatus. A new alpha-emitting isotope, At^{202}, was identified, as were new isomers of At^{204} and At^{206}. The isotopes observed, their half-lives, and associated alpha group energies are tabulated. Alpha groups with energies of 6.412 ± 0.009 and 6.465 ± 0.011 Mev (relative intensities about 60 and 40%, respectively) and an overall half-life of 0.9 ± 0.2 min are tentatively assigned to At^{200}. Alpha-gamma coincidence measurements have shown 68-kev photon to be in coincidence with the 5.696-Mev At^{206} alpha particles. Upper limits were set for photons in coincidence with the other alpha groups studied. No evidence was found for the alpha decay of the 25-min At^{204} and 2.9-hr At^{206} electron-capture activities that were previously studied. (auth)

41871 (UCRL-10541) THE AVERAGE ENERGY AND ANGULAR MOMENTUM REMOVED FROM Dy COMPOUND NUCLEI BY NEUTRONS AND PHOTONS. John M. Alexander and Gabriel N. Simonoff (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 7, 1963. Contract W-7405-eng-48. 49p.

Excitation functions are presented for many heavy-ion-induced (HI) reactions that produce Dy^{149}, Dy^{150} and Dy^{151}. Projectiles were C^{12}, N^{14}, N^{15}, O^{16}, O^{18}, F^{19}, and Ne^{20} of 4 to 10.4 Mev per amu. The reactions studied are all of the type (HI,xn), where x ranges from 3 to 9. A large fraction of the total reaction cross section is accounted for by these (HI,xn) reactions $-^9/_{10}$ at approximately 45 Mev to $^1/_2$ at approximately 105 Mev. An analysis to obtain the energy of the first neutron is presented. Comparison of the results of this analysis to angular-distribution studies suggests that each neutron removes 2 to 4 ħ units of angular momentum. The relation between the average total photon energy and the average angular momentum removed by photons is obtained. Comparison with the average photon energy from other work leads to an average of 1.8 ± 0.6 ħ for the angular momentum removed by each photon. The excitation energy E_J of the lowest-lying state of spin J was estimated. (auth)

41872 (UCRL-10582) CONVERSION ELECTRON MEASUREMENTS IN THE DECAY OF 11.5-d Ba^{131}. W. H. Kelly and D. J. Horen (California. Univ., Berkeley. Law-

rence Radiation Lab.). Oct. 1962. Contract W-7405-eng-48. 39p.

The internal conversion electron spectrum accompanying the decay of 11.5-day Ba^{131} was reinvestigated, and a total of 32 transitions was observed. On the basis of energy sums and relative intensities, a consistent decay scheme is proposed with levels at 78.6, 123.7, 133.5, 215.8, 372.8, 584.8, 619.6, 696.3 and 1046.5 kev. These results clarify the coincidence data of other workers. The multipolarities of some transitions were established by experimentally determined L-subshell ratios, K/L ratios and internal conversion coefficients. Delayed coincidence measurements tend to confirm the 13.3-ns half-life for the 133.5-kev level. (auth)

41873 (WASH-1044) REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP. Meeting at University of Colorado, August 13–14, 1963. A. B. Smith (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 102p. (EANDC(US)-41)

Recent developments and preliminary data in the cross section measurement program are summarized. (D.C.W.)

41874 (EURAEC-780) INTRODUCTORY INVESTIGATION INTO THE ANALYSES OF IRRADIATED URANIUM. Special Report S 11. O. Tretiakoff (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Mar. 25, 1963. Work Performed under United States–Euratom Joint Research and Development Program. 15p. (A translation)

A comparison is made of the results of experimental studies of composition changes in irradiated uranium with these obtained by calculations. Equations are developed for the U^{235}, Pu^{239}, Pu^{240}, and Pu^{241} contents in uranium, and approximations are made for weak irradiations. Other assumptions are also described. Numerical integration of the equations is made, and the cross section ratios are corrected to bring the results into agreement with experimental data. Error calculations are considered. (D.L.C.)

41875 ON THE COULOMB MECHANISM OF THE NUCLEAR DISINTEGRATION. J. Grabowski (Inst. of Nuclear Physics, Krakow) and J. I. Portnyagin. Acta Phys. Polon., 24: 115-19(1963). (In English)

The disintegration cross section of Be^9 is considered in the Coulomb field of middle and heavy nuclei in channels $Be^9 \rightarrow Be^8 + n$ and $Be^9 \rightarrow Be^{9*} \rightarrow He^5 + \alpha$. In addition, the cross section for the Coulomb fission of heavy nuclei was calculated. (auth)

41876 ON ELASTIC SCATTERING OF HEAVY IONS. S. P. Ivanova and B. N. Kalinkin (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Polon., 24: 121-4 (1963). (In English)

The treatment of the elastic scattering of heavy ions in the quasi-classical approximation is more detailed than previous studies. The smoothness of switching on of the absorption was taken into account. The diffraction maximum observed in experiment was reproduced. It was also established that the curve corresponding to the ratio of the cross section of elastic scattering to that of the Rutherford scattering for strictly fixed energy can have a fine structure. (auth)

41877 CROSS SECTION FOR COMPOUND-NUCLEUS FORMATION IN HEAVY-ION-INDUCED REACTIONS. S. P. Ivanova and B. N. Kalinkin (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Polon., 24: 125-9(1963). (In English)

The compound-nucleus formation cross sections were calculated for a number of reactions. The information about the parameters of nuclear interaction between nuclei, which was obtained from the quasi-classical analysis of experiments on heavy ion elastic scattering, was used. It was established that the account of such an interaction is important. (auth)

41878 POLARIZATION OF 29-Mev He^3 PARTICLES SCATTERED BY A GOLD TARGET. J. Catala, A. Garcia, and J. M. Perez (Universidad, Valencia). Anales Real Soc. Esp. Fis. Quim. (Madrid), Ser. A, 59: 53-8(Mar.-Apr. 1963). (In Spanish)

As part of a program of 29-Mev He^3 particle polarization experiments, preliminary results were found for He^3 + C + Au double scattering. Within the angular range covered, a near zero right-left asymmetry was found according to a predominantly Coulomb scattering. (auth)

41879 STUDY OF THE ELASTIC SCATTERING $O^{16}(d,d)O^{16}$ FOR SIX DIFFERENT BEAM ENERGIES, BETWEEN 8.0 and 10.5 Mev. J. Catala, A. Garcia, and R. Diez (Universidad, Valencia). Anales Real Soc. Esp. Fis. Quim. (Madrid), Ser. A, 59: 59-66(Mar.-Apr. 1963). (In Spanish)

The $O^{16}(d,d)O^{16}$ elastic scattering was studied at six different deuteron energies from 8.0 to 10.5 Mev. The corresponding differential cross sections and angular distributions are shown in the range of 12°30′ to 175°. A Fraunhofer analysis of the ratio $\sigma_E(\alpha)/\sigma_R(\alpha)$ between experimental and Rutherford differential cross sections was carried out to obtain the black disk interaction radii. (auth)

41880 MASS SEPARATED ALPHA ACTIVITIES PRODUCED BY CARBON ION BOMBARDMENTS ON THALLIUM, LEAD, AND BISMUTH TARGETS. J. Uhler, W. Forsling, and B. Åstroem (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 24: 421-8(1963). (In English)

In order to study alpha-radioactive nuclides in the atomic number region 83 to 88 with special emphasis on mass number determinations, targets of thallium, lead, and bismuth were bombarded with carbon ions in the Stockholm 225-cm cyclotron. Fractionated isotope separation was utilized for the determination of the atomic numbers of the nuclides. This method is applicable for elements with volatility properties sufficiently divergent. A qualitative comparison was made of the yields of reaction products from the three different targets mentioned. In the bismuth bombardments unexpectedly neutron-rich nuclides were produced. (auth)

41881 K INTERNAL CONVERSION COEFFICIENTS OF TRANSITIONS IN Ba^{134}. A. K. Hankla, J. H. Hamilton, and R. V. Stockehdal (Vanderbilt Univ., Nashville). Arkiv Fysik, 24: 429-37(1963). (In English)

K internal conversion coefficients were measured for the $2+ \rightarrow 0+$, 605-kev transition and for the 563- and 569-kev transitions, which were assigned $2+ \rightarrow 2+$ and $4+ \rightarrow 4+$, respectively, in Ba^{134}. These measurements were carried out with an iron-free, double-focusing spectrometer by using the internal-external conversion method. Possible instrumental distortions of the data were investigated. ϵ_K of the 605-kev transition was measured to be $(4.65 \pm 0.3) \times 10^{-3}$. This may be compared with the theoretical E2 value of 5.1×10^{-3} from Sliv and Band and from Rose. ϵ_K values of $(5.5 \pm 1.0) \times 10^{-3}$ and $(8.5 \pm 1.3) \times 10^{-3}$ were measured for the 563- and 569-kev transitions, respectively. From the conversion coefficient data, mixing ratios were determined to be ≈100% E2 for the 563-kev transition and ≈100% M1 for the 569-kev transition. (auth)

41882 LEVELS IN Tb^{157} POPULATED IN THE DECAY OF Dy^{157}. Lars Persson, Hans Ryde, and Karin Oelsner-Ryde (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 24: 451-78(1963). (In English)

The 8.06-hr electron-capture decay of Dy^{157} was investigated in detail using beta and gamma spectrometers. The activity was produced by a (p,3n) reaction on Tb^{159}, and the dysprosium fraction was isolated by ion-exchange chromatography. Nuclear transitions in Tb^{157} were observed with the following energies: 60.82, 83.01, 143.83, 182.20, 265.34, 326.16, 554, 577, 597, 636, 743, 769, 775, 985, and 992 kev. The internal K conversion coefficient of the intense 326-kev gamma ray was measured to be 1.16×10^{-2}, indicating E1 character. From the relative electron and gamma intensities the conversion relations are then deduced for the remaining transitions. From a comparison with the theoretical conversion coefficients the possible multipole orders of the transitions are discussed. The transitions observed having energies below 326 kev are inserted in the decay scheme with excited levels at 61, 144, and 326 kev. This is in its main features confirmed by coincidence measurements. The transitions with energies above 326 kev, earlier not reported, have very low intensities. New levels in Tb^{157} are suggested having the energies 597, 637, and 992 kev, and the possibility of β- and γ-vibrational character of these levels is discussed. (auth)

41883 CAPTURE CROSS SECTIONS FOR NEUTRONS WITH ENERGIES UP TO 50 kev OF CERTAIN STRUCTURAL MATERIALS. S. P. Kapchigashev and Yu. P. Popov. At. Energ. (USSR), 15: 120-6(Aug. 1963). (In Russian)

Design of fast and epithermal reactors requires the knowledge of neutron capture cross sections in the range from thermal energies to several hundreds of kev. In view of the contradictory values reported in the literature, measurements were carried out for the purpose of obtaining neutron cross section values from the slowing-down time in lead, using a neutron spectrometer. Even though the time resolution of the instrument was poor, (about 30% at $E \leq 1$ kev and 70% at 15 kev), the values obtained are considered to be useful in reactor design studies. The following, previously unknown resonances were found: Ni – 2.3 kev; Cu^{63} – 100 ev and Mo – 12 ev. The radiation widths of the resonances of Cu at 227 and 580 ev were found to be equal to about 0.6 ev. In the case of Mo^{100} the area under resonance at E = 367 ev was found to be smaller by a factor of 2 than the value calculated on the basis of D. Hughes and R. Schwartz's data (BNL-325, second edition 1958; Suppl. 1960). The averaged cross section values of even–even nuclei were found to be five times smaller than the corresponding values of odd-even nuclei. The capture cross section of W agreed well with the data reported by J. Gibbons and R. Macklin et al. (Phys. Rev., 122: 182 (1961); Ibid 107: 504(1957)). (TTT)

41884 ACTIVATION OF VARIOUS MATERIALS BY IRRADIATION WITH 660-Mev PROTONS. M. M. Komochkov. At. Energ. (USSR), 15: 126-30(Aug. 1963). (In Russian)

In order to provide reliable protection of operating personnel against induced radiation, steps must be taken to reduce the induced β and γ activities in materials exposed to the beam of synchrocyclotrons and similar devices. This may be achieved by improving the focusing of the beam on the target and attenuation of scattered particle beams by materials which are activated only slightly or form only short-lived isotopes. A study was therefore undertaken for the purpose of determining which materials satisfy the second condition when exposed to a 660-Mev proton beam. The specimens which included Be, graphite, Mg, duralumin, vitreous silica, porcelain, concrete, heavy concrete, ordinary and stainless steel, Cu, brass, and oxides of Ni, Ti, Cr, and Mn, were irradiated for 40 minutes in an external beam of the synchrocyclotron, with a dose rate between 2×10^8 to 2×10^9 protons/cm^2 sec; supplementary irradiations were carried with the inner beam, reaching a level of 10^{10} protons/cm^2 sec. It was found 1 hour after the termination of the exposure the specific activities of materials varied from 15 to 700 mg equival. Ra/g. Similar measurements carried out 1000 hours after the irradiation yielded activities ranging from 0.4 to 250 mg equivalent Ra/g. Under these conditions, the γ dose rate of the light-metal (Al, Mg) alloys was found to be 2 to 7 times less than that of the heavy-metal alloys, containing Fe or Cu. In the case of light metals, activation of the impurities plays an important role. A good agreement was found between theoretical and experimental data. (TTT)

41885 CALCULATION OF PHOTONEUTRON YIELDS FROM MIXTURES CONTAINING SiO_2 AND SMALL AMOUNTS OF BERYLLIUM, WATER, LITHIUM, CARBON, URANIUM AND THORIUM. A. M. Parlag, A. D. Suvorov, V. A. Shkoda-Ul'yanov and L. A. Shabalina. At. Energ. (USSR), 15: 146-51(Aug. 1963). (In Russian)

In view of the relatively low (γ,n) reaction threshold of Be, D, Li, C^{13}, U, and Th, it was deemed of interest to extend the photoneutron method which used previously with good success for Be, to the above-mentioned elements, found in ores. The calculations were carried out on basis of the Belen'kii-Tamm avalanche method, determining the photoneutron yields from thick specimens containing a mixture of sand and the above mentioned elements. An electron or γ quanta beam was directed onto the specimens and the photoneutron yield was calculated from the critical energy, assuming an SiO_2 density of 1.5 g/cm^3; the obtained values were recalculated on the basis of the natural distribution of the elements. For dry ores, the contribution of D to the photoneutron yield may be neglected. It was found desirable to use energies in the threshold range in order to separate and determine quantitatively the various elements. The sensitivity and the accuracy of the method with respect to Be may be increased by using electron accelerators. The values obtained may be of interest in developing methods of U ore beneficiation and for carrying out rapid analyses. (TTT)

41886 DELAYED NEUTRONS FROM PLUTONIUM-239. B. P. Maksyutenko. At. Energ. (USSR), 15: 157(Aug. 1963). (In Russian)

Analyzing the decay curve of delayed neutrons obtained by the irradiation of Pu^{239} with 15-Mev neutrons for 300 seconds, it was found that the half lives of the first two groups amount to 55 and 22 seconds. The least squares method was used for analyzing the data in the 220 to 280 and 60 to 90 seconds range. From the study of the intensity ratios, a half life value of about 12 seconds was obtained, indicating that a group with a half life of 15.5 seconds contributes markedly to the overall effect. Matrix computations were used to determine the yield ratios. The data show that the ratios of the 24.0 and 15.5-second groups remain identical at neutron energies of 3.8 and 15 Mev. (TTT)

41887 DELAYED NEUTRONS IN THE PHOTOFISSION OF URANIUM-238. K. A. Petrzhak, M. Ya. Kondratko, O. P. Nikotin, and V. F. Teplykh. At. Energ. (USSR), 15: 157-8(Aug. 1963). (In Russian)

The small delayed neutron yield, the low intensity of the bremsstrahlung of the betatron, and the low photofission

cross section of the heavy nuclei are responsible for the current lack of knowledge concerning the delayed neutrons formed by the photofission of delayed nuclei. A previously described apparatus was used to study the photofission of U^{238}, employing the betatron as the source of the bremsstrahlung while the target consisted of natural uranium oxide, placed in the toroidal chamber of the betatron. The delayed neutrons obtained were counted by an assembly of 6 slow neutron counters placed in a paraffin block. The pulses of the counters were amplified and photographed. Steps were taken to exclude the direct betatron beam from the target; this made it possible to carry out neutron activity measurements at a natural background of 2 to 3 pulses per minute. The delayed neutron activity reached its saturation value after 6 minutes. From the overall neutron activity decrease versus time curve the half lives of 3 delayed neutron groups and their yields were determined at maximum bremsstrahlung energies of 14.4, 12.5, and 11.4 Mev. Work is in progress to increase the accuracy of the data and to determine the energy dependence of the yields. (TTT)

41888 SPONTANEOUS-FISSION HALF-LIVES OF PLUTONIUM-240 AND PLUTONIUM-242. L. Z. Malkin, I. D. Alkhazov, A. S. Krivokhatskii, and K. A. Petrzhak. At. Energ. (USSR), 15: 158-9(Aug. 1963). (In Russian)

Previously published values of the half lives of Pu^{240} and Pu^{242} are not sufficiently accurate because only very small amounts of the isotopes were available. A series of measurements was started, using preparations with a small surface density and a high concentration of the isotope studied. A Xe-filled scintillation counter was used as the fission-fragment detector; its resolution was better than that of ionization chambers. Before starting the measurements, the counter was evacuated to 5×10^{-7} mm of Hg, then filled with Xe to a pressure of 2.5 to 3 atm. The stability of the system was tested by measuring the energy spectrum of U^{233} fission fragments. The spontaneous-fission half life of Pu^{240} was found to be $(1.45 \pm 0.02) \times 10^{11}$ years, using a preparation with a surface density of 7×10 microgram/cm^2 and a Pu^{239}/Pu^{240} ratio of 7.04. A second series of tests with a preparation possessing a $Pu^{240}/Pu^{242} = 1.24$ ratio yielded a corresponding half life value of $(7.45 \pm 0.17) \times 10^{10}$ years for Pu^{242}. The energy spectrum of the spontaneous fission fragments is also presented. (TTT)

41889 ANALYSIS OF OVERLAPPING RESONANCES IN PROTON-CARBON SCATTERING. D. Robson and W. Toutenhoofd (Univ. of Melbourne). Australian J. Phys., 16: 370-9(Sept. 1963).

The R-matrix theory of nuclear reactions is discussed for the situation where distant levels must be included and is successfully applied to the elastic scattering of protons by C^{12} in the energy range $E_{LAB} = 10$ to 11.5 Mev, where the resonance levels are overlapping. Definite spin and parity assignments are made for three levels in this region by comparing the predicted excitation functions at several angles of scattering with experiment. Previously unexplained polarization data are explained by this analysis. The optical-model potential is found to be parity dependent for $E_{LAB} < 10$ Mev and yields a close fit to the available data at $E_{LAB} = 8.5$ Mev. (auth)

41890 SPECTROSCOPIC DETERMINATION OF THE NUCLEAR MAGNETIC MOMENT OF PLUTONIUM 241. René-Jean Champeau, Mark Fred, Simon Gerstenkorn, and Frank S. Tomkins (Laboratoire Aimé Cotton, Bellevue, France and Centre d'Etudes Nucléaires, Saclay, France). Compt. Rend., 257: 1238-41(Aug. 5, 1963). (In French)

The study of the hyperfine structure of the I and II spectra of Pu^{241}, carried out using a Fabry-Perot photoelectric spectrometer, shows that the nuclear magnetic moment of Pu^{241} is negative, with a value of -0.58 ± 0.15 nuclear magnetons. (tr-auth)

41891 TENSORIAL PARAMETERS OF THE ELASTIC SCATTERING OF 22-Mev DEUTERONS BY CALCIUM. René Beurtey, Robert Maillard, André Papineau, and Jacques Thirion (Centre d'Etudes Nucléaires, Saclay, France). Compt. Rend., 257: 1477-80(Aug. 12, 1963). (In French)

The elastic scattering of tensorially polarized 22-Mev deuterons by Ca is studied. The differences in counting rates for opposing polarizations show the tensorial polarization of the primary beam and permit studies to be made of the angular variations of two of the tensorial scattering parameters. (tr-auth)

41892 COMPOUND NUCLEAR REACTIONS AND STATISTICAL THEORY. M. Bormann and H. Neuert (Inst. for Experimental Physics, Hamburg). Fortschr. Physik, 11: 277-323(1963). (In German)

The compound-nucleus hypothesis and the statistical theory of nuclear reactions are discussed. Experimental testing of the statistical theory is described. (M.C.G.)

41893 COMPTON SCATTERING OF 662 kev GAMMA RAYS FROM IRON. M. Singh, S. Anand, and B. S. Sood (Panjab Univ., Chandigarh, India). Indian J. Pure Appl. Phys., 1: 305-7(Aug. 1963).

The differential Compton scattering cross sections of 662-kev gamma rays, for iron at angles ranging from 20 to 90° were measured, using a constant efficiency dedector of gamma rays. The values agree with those calculated from the Klein-Nishina formula. (auth)

41894 TOTAL CROSS-SECTIONS OF GAMMA RAYS IN THE ENERGY REGION 0.6-1.33 Mev. A. Seshagiri Rao, J. Rama Rao, V. Lakshminarayana, and Swami Jnanananda (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys., 1: 350-3(Oct. 1963).

The total cross sections of gamma rays of energies 0.604, 0.796, 0.885, 1.119, 1.172, and 1.332 Mev were determined in the elements aluminum, copper, cadmium, and lead, using a fast-slow Compton scintillation spectrometer with an effective resolving time of 120 millimicroseconds. A general agreement was observed between the present experimental values and those obtained in an earlier investigation. The dilution effect of the cross sections noticed in the previous investigation for lower energy photon groups was eliminated by the use of Compton scintillation spectrometer. The experimental values of the cross sections obtained have shown good agreement with the theoretically computed values at all energies. The cross sections in lead, however, differed from the theoretical values, with the discrepancy increasing towards lower energies. These definite deviations are ascribed to the theoretical errors inherent in the estimation of photoelectric and total scattering cross sections. (auth)

41895 EFFECTIVE ATOMIC NUMBERS OF ALLOYS FOR PAIR CREATION. J. Rama Rao, V. Lakshminarayana, and Swami Jnanananda (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys., 1: 375-6(Oct. 1963).

Average atomic pair cross sections in two rhodium–platinum alloys were determined, employing scandium-46, cobalt-60, europium-(152 + 154), and antimony-124 sources and a coincidence scintillation spectrometer. Using previous experimental data on the Z-dependence of pair cross section, the effective atomic numbers for pair interaction, Z^p_{eff}, of the alloys were deduced. The values of Z^p_{eff} obtained

with different sources for each alloy showed good agreement among themselves. The observed constancy of Z^{p}_{eff} for each alloy, in the energy region studied, supports the viewpoint that the effective atomic number deduced from a specific interaction is characteristic of the alloy, unlike the effective atomic number deduced from the total interaction. (auth)

41896 NUCLEAR ORBITAL STRUCTURE. Bernard L. Cohen. Intern. Sci. Technol., No. 23, 65-70; 72; 74 (Nov. 1963).

Nuclear structure is discussed in terms of shell models for the nucleons with each allowed orbit characterized by four quantum numbers. Also included are nucleon interactions, distortion of nuclei, and radioactivity and tunneling. A discussion of each phenomenon is given using a shell model for the nucleus. (R.E.U.)

41897 RELATIVE YIELDS OF THE PAIRS ^{95g}Nb–^{95m}Nb AND ^{96}Nb–^{95}Nb IN FISSION OF Pb, Bi, Th AND U INDUCED BY 15-157 Mev PROTONS. Einar Hageboe (Uppsala Univ.). J. Inorg. Nucl. Chem., 25: 1201-11(Oct. 1963).

The ratio between the fission yield of the high spin isomer was measured for the isomeric pair Nb^{95g}–Nb^{95m} as a function of the irradiation energy and of the target used. For all the targets used, the isomeric yield ratio increases with increasing proton energy, and for a given irradiation energy, the ratio is highest when lead is irradiated and lowest when uranium is irradiated. A simple statistical model calculation indicates that the spin of the primary fission fragment produced by the fission of uranium is very low for low bombarding energies. In the same experiments the ratio between the fission yields of 24 hr Nb^{96} and Nb^{95} was also measured. (auth)

41898 THE YIELDS OF THE ISOMERS OF ^{81}Se AND ^{83}Se IN THE THERMAL NEUTRON FISSION OF ^{239}Pu. I. F. Croall and H. H. Willis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. Nucl. Chem., 25: 1213-18(Oct. 1963).

The cumulative yields of Se^{81}, Se^{81m}, Se^{83}, Br^{83}, and Br^{84} in the thermal neutron fission of Pu^{239} have been measured radiochemically. From these results and previous studies of the selenium isomer yields in U^{235} fission, it was concluded that the ratio of the formation cross section for the high spin isomer Se^{83} to the total formation cross section for both isomers is >0.8. Calculations based on a statistical theory of spin distributions of the nuclear level density indicate that the fragments produced in Pu^{239} fission have a mean intrinsic angular momentum of the order of eight units. (auth)

41899 STUDY OF THE SECONDARY EMISSION OF ELECTRONS FROM THICK TARGETS SUBJECTED TO 1-Mev PROTON BOMBARDMENT. M. S. Gorodetzky, A. M. Bergdolt, A. Chevallier, M. Brès, and R. Armbruster (Institut de Recherches Nucléaires, Strasbourg). J. Phys., 24: 374-8(June 1963). (In French)

The study of secondary emission induced by protons is made for incident energies of 1 Mev. The secondary emission coefficient is measured on Be, Al, Cu, Ta, and Au. The energy distributions of secondary electrons are measured at different angles, with a magnetic spectrometer. The detector is a multiplier system of 17 stages with Cu–Be dynodes. (auth)

41900 GAMMA SPECTRA AND PERIODS OF FOUR ODD-A ISOTOPES OF TUNGSTEN AND TANTALUM. A. Santoni, A. Caruette, and J. Valentin (Laboratoire de Physique Nucléaire, Orsay, France). J. Phys., 24: 407-9 (June 1963). (In French)

The gamma spectra and lifetimes of the Ta and W isotopes having mass numbers 173, 175, 177, and 179 are determined. (T.F.H.)

41901 ENUMERATION OF NUCLEAR PROCESSES INVOLVING THE SIMULTANEOUS EMISSION OF SEVERAL NEUTRONS. Jacques Jacquesson (Commissariat à l'Énergie Atomique, Paris). J. Phys., 24: Suppl. to No. 6, 112A-16A(June 1963). (In French)

By moderating the neutrons simultaneously emitted they can be made to appear in an appropriate detector as a series of pulses correlated in time. By comparing the countings of these pulses without or with dead-time, the redundancy of distribution is measured, the deviation from the Poisson law being caused by multiple processes. Experimentally the two countings are done during the same time on two lines, one with a very short dead-time (fast line), the other with a dead-time greater than the life of neutron in the moderator (slow line). This method allows the measurement of multiple processes as spontaneous or induced fissions, or (n,2n) reactions in presence of single processes. It is applied to the determination of the concentration of Pu-240 in samples of Pu. The accuracy, estimated by comparison with mass spectroscopy, is 0.5%. (auth)

41902 THE 1330 kev RESONANCE LEVEL OF THE $Be^{9}(p,\gamma)B^{10}$ REACTION AND EXCITED STATES OF B^{10}. Bunji Furubayashi, Eizo Teranishi, and Misao Kageyama (Electrotechnical Lab., Tokyo). J. Phys. Soc. Japan, 18: 1235-46(Sept. 1963).

A broad resonance (Γ_{lab} = 383 kev) was observed around E_p = 1330 kev in the measurement of excitation function of the $Be^{9}(p,\gamma)B^{10}$ reaction in the proton energy region from 1200 to 1900 kev. At this level, 7.78 Mev γ ray (γ_0) was predominant (>83%) among the capture γ rays, and its angular distribution was isotropic within the experimental error. Obtained Γ_γ was 14.6 ± 1.5 ev. These results support the assignment 2^- to this level, but the strong E1 transition to the ground state should suggest a large admixture of isotopic spin impurity of T = 1 in T = 0 at this level. The branching ratio of decaying γ rays, the angular distribution and the large isotopic spin admixture are interpreted by the jj-coupling shell model, and the 1330 kev level is identified as a weak coupling s-wave proton resonance analogous to the 330 kev level. On the basis of this identification, other broad levels at E_x = 7.20, 8.07, 8.66, 9.7, and 10.7 Mev in B^{10} are interpreted in terms of the core (Be^{9} or B^{9}) excitation of B^{10} nucleus, and J^π and T of these levels are tentatively assigned. (auth)

41903 ON INEQUALITY OF KNIGHT SHIFTS FOR Li^{6} AND Li^{7}. Toshinosuke Muto and Syoiti Kobayasi (Tokyo Univ.). J. Phys. Soc. Japan, 18: 1350-1(Sept. 1963).

The isotope effect of Knight shift is discussed using both K_0 and K_1, the Knight shift for rigid lattice and the effect of lattice vibrations, respectively. (R.E.U.)

41904 A COMPARISON OF FISSION FRAGMENT MEASUREMENTS MADE BY DOUBLE-ENERGY AND DOUBLE-VELOCITY TECHNIQUES. H. C. Britt, H. E. Wegner, and S. L. Whetstone, Jr. (Los Alamos Scientific Lab., N. Mex.). Nucl. Instr. Methods, 24: 13-21(July 1963). (LADC-5633). (In English)

The energies of two coincident fission fragments emitted from spontaneous fission of Cf^{252} and 25.5-Mev-He^{4} induced fission of U^{233} are measured with semiconductor detectors. The mass distributions and the average total kinetic energy release as a function of the mass ratio obtained from these measurements are compared in detail with results obtained by the double-velocity time-of-flight

technique. For Cf^{252} this comparison shows that the distributions obtained from double-energy measurements are affected by the emission of several prompt neutrons from the fragments, and that if the results are corrected to account for these neutron effects, agreement can be obtained between the double-energy and double-velocity measurements. For He^4-induced fission of U^{233}, which involves a more highly excited fissioning nucleus, the neutron effects are apparently less serious, so the double-energy results require only relatively simple corrections. The agreement between results obtained using the two techniques confirms the validity of the calibration procedure for the semiconductor detectors, and suggests that precision experiments can be performed with a semiconductor detector system if corrections are made for the effects of prompt-neutron emission. (auth)

41905 COLLECTIVE E0 TRANSITIONS AND THE NUCLEAR SHAPE. Ken-ji Hara (Tokyo Univ. of Education). Nucl. Phys., 46: 385-400(Aug. 1963). (In English)

The reduced E0 transition probability is calculated using both the Bohr-Mottelson and the Davydov-Filippov models. It seems to be possible to distinguish these two models by precise E0 measurements, because the E0 process is one of the nuclear shape dependent phenomena. (auth)

41906 (p,α) REACTIONS ON THE EVEN NUCLEI Ni^{58}, Ni^{60} AND Fe^{56}. Isao Kumabe, Hiroshi Ogata, Takesi Komatuzaki, Nobuyuki Inoue, Shigeharu Tomita, Yasumasa Yamada, Tetsuji Yamaki, and Shinji Matsumoto (Kyoto Univ.). Nucl. Phys., 46: 437-53(Aug. 1963). (In English)

The angular distributions of the reactions $Ni^{58}(p,\alpha)Co^{55}$, $Ni^{60}(p,\alpha)Co^{57}$, and $Fe^{56}(p,\alpha)Mn^{53}$ leading to the ground and several excited states of the residual nuclei were measured at 12.6 to 14.25 Mev, at 10.02 to 14.43 Mev, and at 11.0 Mev, respectively, making use of solid-state detectors. Levels were found in Co^{55} at 1.8 ± 0.2, 2.2 ± 0.2, and 2.45 ± 0.2 Mev and in Co^{57} at 1.77 ± 0.02, 2.08 ± 0.03, and 2.21 ± 0.03 Mev. It was found that at about 14 Mev the forward peaks are predominant in the angular distributions for the reactions $Ni^{58}(p,\alpha)Co^{55}$ and $Ni^{60}(p,\alpha)Co^{57}$ leading to the ground states of the residual nuclei. The forward peaking disappears gradually with decreasing proton energy. The angular distributions of the reactions $Ni^{58}(p,\alpha)Co^{55}$ and $Ni^{60}(p,\alpha)Co^{57}$ leading to the several excited states of the residual nuclei have approximately 90° symmetry. The angular distributions of the reaction $Ni^{58}(p,\alpha)Co^{55}$ leading to the ground state of Co^{55} were measured at 28 energies between 8.96 and 10.32 Mev. Sharp variation of the shape of the angular distribution with the bombarding energy was obtained. The results of the measurements were analyzed with the theory of the compound nucleus developed by Ericson. (auth)

41907 (p,α) REACTIONS ON THE ODD-MASS NUCLEI Cu^{63}, Cu^{65}, As^{75} and Rh^{103}. Isao Kumabe, Hiroshi Ogata, Takesi Komatuzaki, Nobuyuki Inoue, Shigeharu Tomita, Yasumasa Yamada, Tetsuji Yamaki, and Shinji Matsumoto (Kyoto Univ.). Nucl. Phys., 46: 454-70(Aug. 1963). (In English)

The angular distributions of the reactions $Cu^{63}(p,\alpha)Ni^{60}$, $Cu^{65}(p,\alpha)Ni^{62}$, $As^{75}(p,\alpha)Ge^{72}$, and $Rh^{103}(p,\alpha)Ru^{100}$ leading to the ground and several excited states of the residual nuclei were measured in the proton energy range between 8 and 14 Mev. For the reactions $Cu^{63}(p,\alpha)Ni^{60}$, $Cu^{65}(p,\alpha)Ni^{62}$, and $As^{75}(p,\alpha)Ge^{72}$, the angular distributions are generally most forward peaked for the alpha particle group corresponding to the ground state of the residual nucleus at the highest proton energy, and then approach 90° symmetry when the proton energy is decreased. When the angular distributions corresponding to the various states of the residual nucleus at a given incident proton energy are compared, it is observed in general for Cu and As that the forward peaking in the angular distribution is most prominent for the alpha particle group corresponding to the ground state and that this peaking gradually disappears with increasing excitation energy of the residual nucleus. For the reaction $Rh^{103}(p,\alpha)Ru^{100}$, all the angular distributions are observed to be more or less forward peaked. (auth)

41908 GAMMA RADIATIONS FROM EXCITED STATES OF N^{16}. W. W. Givens, T. W. Bonner, Sheng Heng Fang, R. C. Bearse, and A. A. Rollefson (Rice Univ., Houston, Tex.). Nucl. Phys., 46: 504-18(Aug. 1963). (In English)

A magnetic-lens type beta-ray spectrometer was used to study the radiations from the reaction $N^{15}(d,p)N^{16}$. Targets of CrN^{15} were made by induction-heating chromium foils to 1300°C in a N^{15}-enriched gas atmosphere. Photoelectron spectra of γ rays K-converted in Cd and Au radiators yielded γ-ray energies of 397.3 ± 1.0, 296.2 ± 1.0, 275.9 ± 1.0, 120.1 ± 0.5, and 100 ± 3 kev. Excited levels of N^{16} at 397.3 ± 1.0, 296.2 ± 1.0, and 120.1 ± 0.5 kev are inferred from the γ-ray energies. The K internal conversion coefficient of the 120 kev first-excited to ground state transition of N^{16} was measured by the external-internal conversion method to be $7.23(1 \pm 0.20) \times 10^{-3}$. This value shows the 120 kev transition to be E2, which is consistent with the previously indicated spin and parity assignments of 2^- and 0^- for the ground level and first-excited level, respectively. The relative γ-ray branching of individual levels was also measured. (auth)

41909 THE PARITY OF THE 95 kev FIRST-EXCITED LEVEL OF O^{19}. W. W. Givens, R. C. Bearse, G. C. Phillips, and A. A. Rollefson (Rice Univ., Houston, Tex.). Nucl. Phys., 46: 519-27(Aug. 1963). (In English)

A lens type beta-ray spectrometer was used to measure the K internal conversion coefficient of the first-excited to ground state transition in O^{19}. The levels of O^{19} were excited by the reaction $O^{18}(d,p)O^{19}$. The value of the K internal conversion coefficient was measured to be $6.27(1 \pm 0.18) \times 10^{-4}$. This value is indicative of an M1 transition which establishes the parity of the first-excited level of O^{19} as positive. The energy of the first-excited level was determined from internal conversion electron and photoelectron spectra to be 95 ± 2 kev. (auth)

41910 NUCLEAR RECOIL IN SOLIDS. 3. THE REACTION $Al^{27}(n,\alpha)Na^{24}$. D. Ertel and K. E. Zimen (Hahn-Meitner-Institut für Kernforschung, Berlin). Nukleonik, 5: 256-8(Sept. 1963). (In German)

For the reaction $Al^{27}(n,\alpha)Na^{24}$ with reactor neutrons, the experimentally found average recoil range for Na^{24} in aluminum amounted to $(0.91 \pm 0.02) \times 10^{-4}$ cm. This average value resulted from measurements of the recoil atoms appearing from aluminum foils of determined thickness according to the target-capture method. Under certain assumptions a value, for the range of Na^{24}-recoil atoms with an energy of 1 Mev, of 6.5×10^{-4} was obtained. (tr-auth)

41911 ^{232}Th AND ^{238}U FISSION INDUCED BY LOW-ENERGY MONOCHROMATIC GAMMA-RAYS. II. ANGULAR DISTRIBUTIONS AT 6.61 Mev. H. G. de Carvalho (Istituto Nazionale di Fisica Nucleare, Rome and Università, Rome), A. Manfredini, M. Muchnik, M. Severi, R. Boesch, and W. Woelfli. Nuovo Cimento (10), 29: 463-75(July 16, 1963).

The angular distribution of the photofission fragments of uranium and thorium was measured at 6.61 Mev by com-

bining a new type of monochromatic γ-ray source with some new developments of the nuclear emulsion technique. Values are given for the isotropic, dipole, and quadrupole absorption cross sections in the photofission process. (auth)

41912 DEUTERON AND α-PARTICLE PRODUCTION IN CARBON AND POLYETHYLENE BY 26.6 Gev/c PROTONS. U. Amaldi, Jr., T. Fazzini, G. Fidecaro, G. Ghesquière, M. Legros, and H. Steiner (CERN, Geneva). Nuovo Cimento (10), 29: 476-86(July 16, 1963).

The production of deuterons in p-p collisions was investigated by comparing the yield of deuterons from carbon and polyethylene targets exposed to the 26.6-Bev/c circulating proton beam of the CERN proton synchrotron. The deuterons were observed at 11.25° l.s. The yields from CH_2 and C were normalized to the same number of interactions in carbon. These were monitored by counting the α particles produced. The measurements were performed with deuterons having momenta of 1550, 1480, and 700 Mev/c. There was no evidence of deuteron production from hydrogen within the accuracy of the experiment. An upper limit of 34 μb/(sr Bev/c) for the cross section for producing deuterons in p-p collisions was established with a 98% confidence level. This small value, although not in contradiction with the statistical calculations, strongly indicates the nuclear origin of the majority of the deuterons observed at our angle in high-energy collisions. (auth)

41913 M1-E2 MIXING RATIOS IN 2^+-2 TRANSITION IN EVEN-EVEN NUCLEI AS A TEST OF THE PURITY OF THE VIBRATIONAL STATES. S. M. Brahmavar and M. K. Ramaswamy (Karnatak Univ., Dharwar, India). Nuovo Cimento (10), 29: 549-50(July 16, 1963).

An attempt is made to correlate the deviation of the ratio E_2^1/E_2 from 2 with the mixing ratio (M1-E2) in the 2^+-2 transition (from previous studies NSA 17: 17172) in order to obtain a measure of the particle interaction with the collective states. For nuclei of $58 \leq A \leq 198$, the data is summarized. (R.E.U.)

41914 CENTER-OF-MASS EFFECT ON ELECTROMAGNETIC TRANSITION RATES IN MESIC ATOMS. Z. Fried (Naval Ordnance Lab., Silver Springs, Md.) and A. D. Martin. Nuovo Cimento (10), 29: 574-6(July 16, 1963).

The possible enhancement of the mesic radiative and Auger transition rates arising from the motion of the nucleus about the center of mass of the mesic atom is discussed. (R.E.U.)

41915 ANGULAR DISTRIBUTION OF π^- MESONS AT 960 Mev/c SCATTERED ON NUCLEI. M. Crozon, T. Leray, and J. Tocqueville (Faculté de Sciences, Paris). Nuovo Cimento (10), 29: 655-69(Aug. 1, 1963). (In French)

Differential cross-sections were measured for negative pion scattering on nuclei at 960 Mev/c. The target elements used were C, Al, and Cu. An attempt was made to separate elastic and quasi-elastic scattering from true-inelastic processes. The results show a good agreement with the predictions of the optical model. The nuclear radius and the fall-off parameter were taken to be approximately those determined from nuclear charge distribution measurements. Some discrepancies between experimental and predicted values of σ are discussed. (auth)

41916 ON SOME CAUSES OF SPURIOUS SCATTERING IN NUCLEAR EMULSIONS. P. K. Aditya, V. S. Bhatia, and P. M. Sood (Panjab Univ., Chandigarh, India). Nuovo Cimento (10), 29: 577-88(Aug. 1, 1963).

From multiple Coulomb scattering measurements, carried out in two planes, one perpendicular and the other parallel to the plane of the emulsion, it was found that the dislocations in depth are strongly correlated with the dislocations in projection, the magnitude of the former being about four times that of the latter. It was concluded that in stripped emulsions, the spurious scattering in projection is mainly due to the dislocations in depth. These dislocations in depth, of the tracks, seem to be due to the fact that the plane of the pellicles, at the time of exposure, is not the same as that of the mounted pellicles, the tracks thereby acquiring large dislocations in depth. An attempt was made to explain on this basis, some of the known characteristics of spurious scattering, namely, its small magnitude in glass-backed emulsions, its variation from stack to stack or plate to plate, its dip-dependence and its cell-length-dependence. (auth)

41917 THE EMISSION OF HEAVY HYPERNUCLEI FROM 800 Mev/c K^- INTERACTIONS IN NUCLEAR EMULSION. I. R. Kenyon (Oxford Univ.). Nuovo Cimento (10), 29: 589-957(Aug. 1, 1963).

An investigation of secondary interactions from 800 Mev/c-K^- interactions in nuclear emulsion with very short connecting tracks was undertaken. It is concluded that they are spallation products carrying a bound Λ^0 hyperon. The characteristics of these heavy hypernuclei are described and estimates are made of their nonmesonic to mesonic decay ratio and binding energy. Comparison with similar work is made. (auth)

41918 THE EXCITATION FUNCTION OF THE REACTION $Li^7(p,\gamma)Be^8$ BETWEEN 1 AND 3 Mev. V. Riech (Institut fur Experimentalphysik, Hamburg). Phys. Letters, 6: 267-8(Sept. 15, 1963). (In German)

The proton beam from a Van de Graaff accelerator was used to bombard a target of natural lithium metal. The resulting gamma rays were detected using a NaI(Tl) crystal and the intensities were plotted as a function of proton energy. (R.E.U.)

41919 TRANSITIONS TO 6.06 Mev LEVEL OF O^{16} EXCITED STATES FROM $N^{15}(p,\gamma)O^{16}$. S. Gorodetzky, W. Benenson, P. Chevallier, D. Disdier, and F. Scheibling (Institut de Recherches Nucléaires, Strasbourg). Phys. Letters, 6: 269-71(Sept. 15, 1963). (In French)

The branching ratios of (decay to 6.06-Mev level)/(decay directly to ground state) are measured for several 1^- states and one 1^+ state in O^{16}, namely, the levels at 13.1, 17.13, and 17.3 Mev, and the level at 16.22 Mev, respectively. The results lead to the hypothesis of T = 1 for the 6.06-Mev level. (T.F.H.)

41920 ANALYSIS OF THE 2.3 Mev BETA TRANSITION OF Pr^{144}. G. Schwiderski (Universität, Münster, Ger.). Phys. Letters, 6: 271-3(Sept. 15, 1963). (In English)

An analysis of the 2.3-Mev beta transition is presented to show that the available data are consistent with $I = 1^-$ and that a spin assignment based on unique shape and anisotropy factors is not unambiguous. A graphical method was used to obtain the nuclear matrix elements fitting the experimental data. (R.E.U.)

41921 RESIDUAL-INTERACTION TERMS IN (d,p) REACTIONS. M. Tanifuji (Hosei Univ., Tokyo). Phys. Letters, 6: 276-8(Sept. 15, 1963). (In English)

In the shell model and collective vibrational model, interactions of nucleons are described in terms of an average potential and residual interactions. It is shown how the residual interactions of the neutron can be derived in the form that does not consider the residual interaction mechanism, i.e., the whole interactions are described in terms of those between the emitted proton and the residual nucleus. The

results are compared with the form, which considers the residual interaction, where a neutron in the incident deuteron may be transferred from the deuteron state into a state of the residual nucleus. (R.E.U.)

41922 STUDY OF THE REACTIONS $Li^6(p,pd)$ AND $(p,p\alpha)$ AND $Be^9(p,p\alpha)$ AT 155 Mev. C. Ruhla, M. Riou, M. Gusakow, J. C. Jacmart, M. Liu, and L. Valentin (Laboratoire Joliot-Curie de Physique Nucléare, Orsay, France). Phys. Letters, 6: 282-6(Sept. 15, 1963). (In French)

A proton beam of 155 Mev was obtained from a synchrotron. The angular correlations and energies of the resulting particles were studied. The probability density was investigated for the reactions. (R.E.U.)

41923 BETA DECAY AND SPIN OF Eu^{152m}. S. K. Bhattacherjee (Tata Inst. of Fundamental Research, Bombay), S. K. Mitra, and C. V. K. Baba. Phys. Letters, 6: 286-7(Sept. 15, 1963). (In English)

The spin assignment of 1^- of the isomeric state of Eu^{152} ($T_{1/2}$ = 9.2 hr) was tested by measuring the energy dependence of $\beta_1-\gamma_1$ directional correlation coefficient of the 1511-kev β-group and the 344-kev E2 γ ray over the beta spectrum from 660 to 1400 kev. (R.E.U.)

41924 RENORMALIZATION OF p-p, p-d AND p-He DIFFERENTIAL CROSS SECTIONS MEASURED AT THE HARVARD CYCLOTRON LABORATORY. J. N. Palmieri (Oberlin Coll., Ohio), R. Goloskie, and A. M. Cormack. Phys. Letters, 6: 289(Sept. 15, 1963). (In English)

A 30-cm Faraday Cup was used as the primary beam monitor in measurements of the differential cross section for scattering of protons by hydrogen, deuterium, and helium. The effects of monitor efficiency are shown. (R.E.U.)

41925 THE MAGNETIC MOMENT OF THE 66 kev STATE OF As^{73} AND THE ANGULAR CORRELATION OF THE 359 kev – 66 kev $\gamma\gamma$-CASCADE. E. Bodenstedt (Universitat, Bonn), G. Strube, W. Engels, H. Blumberg, R.-M. Lieder, and E. Gerdau. Phys. Letters, 6: 290-1(Sept. 15, 1963). (In English)

A differential measurement of the time spectrum of the 359- to 66-kev $\gamma\gamma$ coincidences was performed for the two angles 135 and 225°. This was done in an external magnetic field of 36.6 kgauss to observe the spin rotation. The half life of the 66-kev state was found to be (5.0 ± 0.1) nsec. (R.E.U.)

41926 EXCITATION OF ISOBARIC STATES IN (p,n) REACTIONS AT 30 AND 50 Mev. C. J. Batty (Rutherford High Energy Lab., Chilton, Berks, Eng.), G. H. Stafford, and R. S. Gilmore. Phys. Letters, 6: 292-3(Sept. 15, 1963). (In English)

Preliminary measurements are reported of the neutron energy spectra emitted at 0° from a range of medium and heavy nuclei bombarded with 30- and 50-Mev protons. The results clearly demonstrate the excitation of isobaric states in nuclei up to and including uranium. There is evidence for an unexpected variation of the excitation cross section with atomic weight and energy. (R.E.U.)

41927 STATISTICAL MODEL IN FISSION OF U^{235} INDUCED BY THERMAL NEUTRONS. E. Erba, U. Facchini, E. Saetta-Menichella, F. Tonolini, and L. Tonolini Severgnini (Laboratori CISE, Milan). Phys. Letters, 6: 294-5 (Sept. 15, 1963). (In English)

The relative fission probabilities are calculated in the case of the thermal neutron fission of U^{235}. The energy and mass distribution is given for the various fission models without considering the nuclear state immediately preceding the fission, which could possibly be caused by a nonstatistical process. (R.E.U.)

41928 DETERMINATION OF THE CROSS SECTION OF PION-PION INTERACTION FROM THE REACTION $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ AT SMALL MOMENTUM TRANSFER TO THE NUCLEON. A. V. Arefev, Yu. D. Bayukov, Yu. M. Zaitsev, M. S. Kosodaev, G. A. Leksin, V. T. Osipenkov, D. A. Suchkov, V. V. Telenkov, and V. B. Fedorov (Inst. of Theoretical and Experimental Physics, Moscow). Phys. Letters, 6: 299-300(Sept. 15, 1963). (In English)

Results are given of an experiment in which the pion-pion interaction was investigated by the Chew-Low method. (R.E.U.)

41929 UNIQUE SPIN ASSIGNMENT TO THE Pr^{144} GROUND STATE. R. M. Singru, R. S. Raghavan, and R. M. Steffen (Purdue Univ., Lafayette, Ind.). Phys. Letters, 6: 319-20(Oct. 1, 1963). (TID-19404)

Arguments are presented that lead to a unique assignment of $I_0 = O^-$ to the Pr^{144} ground state. (R.E.U.)

41930 ON THE POSSIBILITY OF A $U^{235}(n,\alpha)Th^{232}$ REACTION FOR SLOW NEUTRONS. M. Sowiński, M. Dakowski, and H. Piekarz (Inst. for Nuclear Research, Otwocka, Poland). Phys. Letters, 6: 321(Oct. 1, 1963).

Alpha particles were observed in slow neutron ternary fission of U^{235}. Evidence indicated that these particles were not produced by fission. The production mechanism is studied. (R.E.U.)

41931 ON THE VALIDITY OF THE SUPERMULTIPLET MODEL. P. Franzini and L. A. Radicati (Scuola Normale Superiore, Pisa, Italy and Istituto Nazionale di Fisica Nucleare, Pisa, Italy). Phys. Letters, 6: 322-4 (Oct. 1, 1963).

It is shown that the supermultiplet approximation remains valid for large values of A. The energy differences between states belonging to different supermultiplets were analyzed by comparing the ground-state energies of three isobars. (R.E.U.)

41932 THE DECAY OF 3.9 MIN Xe^{137}. G. B. Holm, U. Faegerquist, and I. Bergstroem (Nobel Inst. of Physics, Stockholm and Royal Inst. of Tech., Stockholm). Phys. Letters, 6: 324-6(Oct. 1, 1963).

An investigation of 3.9-min Xe^{137} was undertaken using an electromagnetic isotope separator. Xe^{137} was produced by slow neutron fission of U^{235}, and gamma and beta spectra were obtained. (R.E.U.)

41933 COULOMB EXCITATION OF BISMUTH WITH α-PARTICLES. A. Z. Hrynkiewicz (Inst. of Nuclear Physics, Krakow), St. Szymczyk, T. Walczak, G. Zapalski, F. Baldeweg, and G. Stiller. Phys. Letters, 6: 326-8 (Oct. 1, 1963).

The excitation of Bi^{209} was investigated by inelastic scattering of alpha particles at 27.25 Mev from a cyclotron source. Gamma spectra were registered in coincidence with back-scattered α particles. Data are given for the Coulomb excitation of 0.91-, 1.6-, and 2.6-Mev levels in Bi^{209}. (R.E.U.)

41934 SPIN OF THE Pr^{144} GROUND STATE. BETA-DECAY MEASUREMENTS ON Ce^{144} AND Pr^{144}. E. Creutz, J. de Raedt, J. P. Deutsch, L. Grenacs, and D. Siddique (Universite, Louvain, Belg.). Phys. Letters, 6: 329-31 (Oct. 1, 1963).

It is shown that the spectrum shape and directional correlation results of the Pr^{144} decay are unable to determine uniquely the spin value of the ground state of this nucleus. The characteristics of the internal beta branch in the decay of Ce^{144} leading to the 133-kev state of Pr^{144} were investigated. A beta-gamma directional correlation measurement on the beta-(133 kev) gamma cascade of Ce^{144} was

undertaken to distinguish between alternative spin assignments. (R.E.U.)

41935 ANGULAR DISTRIBUTION OF NEUTRONS DUE TO μ^--CAPTURE IN CALCIUM FOR VARIOUS ENERGY THRESHOLDS. V. S. Evseev, V. S. Roganov, V. A. Chernogorova, Run-hwa Chang, and M. Szymczak (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 6: 332-3 (Oct. 1, 1963).

Results are given on measurements of the asymmetry coefficient in the angular distribution of neutrons at various thresholds of E_n from 7 to 23 Mev. (R.E.U.)

41936 ON INTERACTION CONSTANTS IN μ^--CAPTURE. M. L. Yovnovich and V. S. Evseev (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 6: 333-6(Oct. 1, 1963).

The interaction constants (vector, pseudoscalar, induced-pseudoscalar, and weak magnetism) are considered in the theoretical determination of the asymmetry coefficient in the angular distribution of neutrons from polarized μ^--meson capture by nuclei. (R.E.U.)

41937 EXCITATION OF PARTICLE-HOLE STATES IN O^{16} BY ELECTRON SCATTERING. P. S. Willey (Univ. of Washington, Seattle). Phys. Letters, 6: 336-8(Oct. 1, 1963).

Wave functions and energies obtained by diagonalizing the assumed interaction in the set of unperturbed particle-hole states are used to calculate the form factors for excitation of levels in O^{16}. (R.E.U.)

41938 ON THE NUCLEAR MOMENT OF ^{61}Ni. J. W. Orton, J. E. Wertz, and P. Auzins (Univ. of Minnesota, Minneapolis). Phys. Letters, 6: 339-41(Oct. 1, 1963).

Nickel oxide enriched to 79.2% Ni^{61} was used in the preparation of MgO powder doped such that the atomic ratio of Ni to Mg was 5×10^{-4}. The ESR spectrum of Ni^{2+} and of Ni^{1+} leads to a hyperfine splitting constant $|A| = 8.18 \times 10^{-4}$ cm^{-1}. It is concluded that there is no anomaly between the Ni^{61} moment value as determined by NMR and that obtained by hyperfine splitting in ESR. (R.E.U.)

41939 SUPERCONDUCTIVITY OF THE U^{238} NUCLEUS. A POSSIBLE EXPLANATION OF THE MEASURED NUCLEAR TEMPERATURE. Z. Lewandowski (Inst. of Nuclear Physics, Krakow). Phys. Letters, 6: 342-3(Oct. 1, 1963).

Observed discrepancies in the nuclear temperature between experiment and the Newton model for uranium-238 are explained. It is proposed that at the moment of neutron evaporation the uranium nucleus is highly deformed. This deformation and a contribution due to rotation and vibration are expected to cool the nucleus diminishing the intrinsic excitation energy. A superconductor structure is assumed for the nucleus. (R.E.U.)

41940 THE ENERGY CORRELATION IN PROTON AND NEUTRON PAIRS FORMED BY THE DISINTEGRATION OF 26-Mev DEUTERONS BY GOLD NUCLEI. F. Udo and L. A. Ch. Koerts (Instituut voor Kernphysisch Onderzoek, Amsterdam). Phys. Letters, 6: 343-4(Oct. 1, 1963).

The total energy of a coincident pair is assumed to be of the form $E_p + E_n = E_d - E_R - 2.23$ Mev, where 2.23 Mev is the binding energy of the deuteron and E_R is the energy of the gold nucleus after collision. E_R is considered negligible. It is concluded that on the basis of this experiment it can be excluded that during the formation of the coincident neutron and proton there occurs an exchange of energy between the deuteron and the nucleus. It is, however, impossible to determine the dominating effect. (R.E.U.)

41941 ON THE $\frac{5}{2}-[523] \rightarrow \frac{7}{2}-[523]$ ELECTRON CAPTURE TRANSITION IN THE DECAY OF Er^{163}. L. Persson (Nobel Inst. of Physics, Stockholm). Phys. Letters, 6: 347-9(Oct. 1, 1963).

The influence of the pairing correlation effect in the unhindered, allowed transitions $\frac{5}{2}-[523] \rightleftharpoons \frac{7}{2}-[523]$ is studied. The gamma spectrum of Er^{163} was studied; it was found that the K x ray line was very strong compared to faint photopeaks of the energies 300, 430, 510, and 1100 kev. The negatron spectrum was also considered the construction of the decay scheme of Er^{163}. Positron spectral distributions were also studied. (R.E.U.)

41942 ANOMALOUS RADIATIVE NEUTRON CAPTURE IN GOLD. O. A. Wasson and J. E. Draper (Yale Univ., New Haven). Phys. Letters, 6: 350-2(Oct. 1, 1963).

Experimental study was undertaken to clarify three aspects of the theory: the potential capture interference in resonance neutron capture; the strength of the channel resonance contribution relative to the internal contribution that should be proportional to the reduced neutron width of each resonance; and the single-particle effects on the random variation for the summed intensity of several transitions. Gold was chosen because it has an isolated low energy resonance that permits greater intensity and resolution. (R.E.U.)

41943 CALCULATION OF NEUTRON BOUND STATES WITH A NON-LOCAL SINGLE PARTICLE MODEL. H. Meldner and G. Suessmann (Universität, Frankfurt am Main). Phys. Letters, 6: 353-4(Oct. 1, 1963).

Results are presented from the calculation of single-neutron energies using a real, nonlocal shell model potential. The parameters were taken from an optical model fit adjusting only the spin-orbit potential to 1450 Mev, which is compatible with the scattering measurements. (R.E.U.)

41944 OVERHAUSER EFFECT IN METALLIC LITHIUM AND SODIUM. Richard Hecht and Alfred G. Redfield (Columbia Univ., New York). Phys. Rev., 132: 972-7 (Nov. 1, 1963).

The Overhauser polarization of nuclear spins in Li and Na metal was precisely measured at 1.5°K and 10.4 G. The electron spin resonance was saturated for a time long compared to the nuclear spin relaxation time, and the resulting Overhauser polarization was then measured by adiabatically applying a high field and sweeping through nuclear resonance in a time short compared to the nuclear relaxation time. The degree of electron saturation was determined with precision by comparison with the change in electron spin magnetization longitudinally measured under the same experimental conditions. For Na the polarization ratio is 100 ± 3% of its high-field theoretical value γ_e/γ_n; for Li, 84 ± 3%. At 10.4 G correction must be made for polarization leakage via the nuclear spin-spin energy; the predicted ratios are 98.5% for Na and 90% for Li, of the high-field values. The remaining discrepancy in Li is presumably a result of conduction electron orbital contribution to the relaxation, which is important because of the predominantly p character of the lithium conduction electron wave functions. The orbital relaxation rate is estimated theoretically for Li, and the result agrees with experiment. (auth)

41945 2P → 1S TRANSITIONS IN MUONIC Tl, Pb, AND Bi. William B. Rolnick (Columbia Univ., New York). Phys. Rev., 132: 1110-19(Nov. 1, 1963).

The mixing of states of a muonic atom with the nucleus in an excited state into the states with the nucleus in the ground state, for natural Tl, Pb, and Bi (due to the multipole

interactions between the nucleus and the muon), is calculated. This effect fails to explain the ratio of the number of $2P_{\frac{1}{2}} \rightarrow 1S_{\frac{1}{2}}$ to $2P_{\frac{3}{2}} \rightarrow 2S_{\frac{1}{2}}$ transitions (expected to be 0.5 in the absence of mixing) as observed by Frati and Rainwater. In Bi, the calculation shows that the mixing is negligible, but the observed ratio was 0.75 ± 0.05; in Tl (where the ratio was 0.97 ± 0.09) the off-diagonal matrix elements of the hamiltonian, required for this effect to be the sole cause of the change of ratio, differs from theory by two standard deviations. For Pb the observed ratio agrees with theory and the calculated mixing is, indeed, negligible. If it is assumed that some unknown effect is acting in Bi and is of the same order of magnitude in Tl, then the difference between the ratio in Tl from that in Bi is explained by the above mixing. This assumption is suggested by the fact that Tl is one proton below and Bi is one proton above a magic number closed shell (82). It is supposed that this unknown effect is absent in Pb since it is a magic number nucleus (82 protons). It is proven that nonresonant effects, due to spin-independent operators, cannot affect the radiative-transition sum rules. This is applied to nonresonant hyperfine mixing and a hypothetical nuclear-Auger effect. (auth)

41946 β-γ CIRCULAR-POLARIZATION CORRELATION STUDY OF Sc^{46}. John A. Miskel, Lloyd G. Mann, and Stewart D. Bloom (Univ. of California, Livermore). Phys. Rev., 132: 1130-3(Nov. 1, 1963). (UCRL-7256)

A series of β circularly polarized γ angular-correlation measurements on Sc^{46} in seven different chemical and physical forms was conducted to investigate a possible chemical effect reported by Boehm and Rogers. According to their findings, this effect attenuates the observed angular correlation. No indication of such an effect was found. The average of all the present measurements (A = +0.097 ± 0.012) is in excellent agreement with an earlier result as well as with many other independent measurements. It is concluded that there is no evidence for a chemical attenuation effect. (auth)

41947 PHOTOPROTONS FROM C^{12} AND F^{19}. K. M. Murray and W. L. Bendel (Naval Research Lab., Washington, D. C.). Phys. Rev., 132: 1134-40(Nov. 1, 1963).

The energy distributions of charged particles from C^{12} and from F^{19}, irradiated with 23.5-Mev bremsstrahlung were measured using a silicon-diode charged-particle detector. The spectrum from carbon is found to consist largely of protons and shows no pronounced resonances. The spectrum from fluorine shows considerable structure, much of which is due to protons. There is evidence that this spectrum contains heavier charged particles. (auth)

41948 NUCLEAR MAGNETIC RESONANCE OF F^{20} BY POLARIZED NEUTRON CAPTURE AND β-DECAY ANISOTROPY. Tung Tsang and Donald Connor (Argonne National Lab., Ill.). Phys. Rev., 132: 1141-6(Nov. 1, 1963).

The nuclear magnetic resonance of F^{20} ($T_{\frac{1}{2}}$ = 11.4 sec) was observed by means of the polarized neutron capture, β-decay anisotropy technique. The nuclear g factor was found to be +1.047 ± 0.001 nm/$\hbar$ (corrected for atomic diamagnetism). The principles of the experiment and the techniques used are discussed. (auth)

41949 PRECISION MEASUREMENT OF THE RECOIL ENERGY SPECTRUM FROM THE DECAY OF He^6. C. H. Johnson, Frances Pleasonton, and T. A. Carlson (Oak Ridge National Lab., Tenn.). Phys. Rev., 132: 1149-65 (Nov. 1, 1963).

The energy spectrum of recoil ions from the β^- decay of He^6 was observed repeatedly under a variety of operating conditions with a spectrometer that uses a tandem arrangement of magnetic and electrostatic analysis. Analyzed ions were detected with an electron multiplier. A composite spectrum is formed from the several observations, random errors are assigned on the basis of the observed fluctuations, and four parameters are adjusted to give the best fit of theory to experiment. These parameters are the maximum β^- energy W_0, an electron-neutrino correlation coefficient α, a normalization constant, and a detector parameter. The analysis gives $\alpha = -0.3343 \pm 0.0030$, where the uncertainty represents a careful evaluation of both random and systematic effects. The conclusion is reached, with 68% posterior probability, that the limit to the tensor interaction is $(|C_T|^2 + |C'_T|^2)/(|C_A|^2 + |C'_A|^2) \leq 0.4\%$. If one assumes that there is no tensor interaction but that higher order terms may be present, then one can conclude from a plane-wave (Z = 0) approximation for the He^6 decay that $b = -(0.5 \pm 1.3)(2\underline{M})^{-1}$, where b is a second-order term defined in Gell-Mann's paper on weak magnetism, and $\underline{M}$ is the ratio of nucleon-to-electron mass. (auth)

41950 LOW-LYING POSITIVE PARITY STATES OF Ne^{21}. R. M. Dreizler (Australian National Univ., Canberra). Phys. Rev., 132: 1166-76(Nov. 1, 1963).

The energy spectrum of Ne^{21} below 6 Mev and some ground-state and excited-state properties are discussed in terms of a model implying the coupling of a s-d particle to a rotational Ne^{20} core. Fair agreement with the experimental data is obtained. A comparison with the standard collective model calculations is given. (auth)

41951 SECOND-ORDER EFFECTS IN POSITRON SPECTRUM OF $Zr^{89}(\frac{9}{2}^+ \rightarrow \frac{9}{2}^+)$. C. P. Bhalla (Westinghouse Electric Corp., Pittsburgh). Phys. Rev., 132: 1177-80(Nov. 1, 1963).

Numerical results of theoretical analysis of the positron shape factor in $Zr^{89}(\frac{9}{2}^+ \rightarrow \frac{9}{2}^+)$ are presented. The experimental beta-shape factor due to Hamilton, Langer, and Smith was taken to be represented by $1 + (b/W)$ where $0.2 < b < 0.4$. Several reasonable fits to this anomalous positron shape factor were obtained within the framework of V-A theory by considering the contribution of the interference terms between the allowed matrix elements and the second forbidden matrix elements. The finite nuclear-size effects and the finite deBroglie wavelength effects were included. (auth)

41952 SPIN AND NUCLEAR MOMENTS OF 6.7-HOUR Cd^{107}. F. W. Byron, Jr., M. N. McDermott, and R. Novick (Columbia Univ., New York). Phys. Rev., 132: 1181-5 (Nov. 1, 1963).

The Zeeman and hyperfine structure of the $(5s5p)\ ^3P_1$ state of 6.7-h Cd^{107} was determined by optical double resonance. Positive identification of the isotope was obtained through the observation of the decay of the Zeeman resonance signals. The nuclear spin (I), magnetic hyperfine-structure coupling constant (A), and the quadrupole coupling constant (B), are $I = \frac{5}{2}$, $A(^3P_1) = -854.2 \pm 1.0$ Mc, and $B(^3P_1) = -166 \pm 3$ Mc. Neglecting possible hyperfine structure anomalies and quadrupole shielding effects, the corresponding nuclear moments are $\mu_{107} = -0.6162(8)\ \mu_N$ and $Q_{107} = +0.77(10)$ b. These moments are compared with the predictions of the configuration mixing model of Noya, Arima, and Horie. The ratio of the Cd^{107} and Cd^{109} quadrupole moments is $Q_{107}/Q_{109} = 0.993(20)$; this result is independent of the shielding corrections. (auth)

41953 LEVEL CROSSINGS IN THE $(5s5p)\ ^3P_1$ STATE OF RADIOACTIVE Cd^{107} AND Cd^{109}. P. Thaddeus (Columbia Univ., New York and Goddard Inst. for Space Studies, New York) and M. N. McDermott. Phys. Rev., 132: 1186-90(Nov. 1, 1963).

Four level crossings, which obey the selection rule $\Delta m_F = 2$, were detected for hyperfine levels in the (5s5p) $^3P_1$ state of both 6.7-h Cd^{107} and 470-day Cd^{109} by observing the change in intensity at 90° of the resonance fluorescence of the 3261 Å intercombination line. The hyperfine interaction constants found from an analysis of the crossing point fields, and corrected for interaction with the adjacent fine structure states of the 5s5p multiplet, are $A_{107} = -853.543(6)$ Mc, $B_{107} = -163.279(5)$ Mc, $A_{109} = -1148.784(7)$ Mc, $B_{109} = -165.143(5)$ Mc. The ratios of the magnetic-dipole moments, and the electric-quadrupole moments, to within the effect of hyperfine anomalies, are $\mu_{107}/\mu_{109} = 0.742997(8)$; $Q_{107}/Q_{109} = 0.98871(4)$. (auth)

41954 LEVEL STRUCTURE OF Ni^{64}. J. K. Dickens, F. G. Perey, and R. J. Silva (Oak Ridge National Lab., Tenn.). Phys. Rev., 132: 1190-2(Nov. 1, 1963).

Excited states of Ni^{64} was investigated through the study of the inelastic scattering of 11-Mev protons from an isotopically enriched target of Ni^{64}. Excitation energies of 30 levels between 1.34 and 5.49 Mev are reported. For the level at 3.55 Mev a spin and parity assignment of 3^- is suggested. (auth)

41955 DIRECTIONAL CORRELATION OF THE GAMMA RAYS OF La^{140} AND Ce^{140}. W. W. Black and Allan C. G. Mitchell (Indiana Univ., Bloomington). Phys. Rev., 132: 1193-9(Nov. 1, 1963).

The directional correlation of coincident gamma rays in La^{140} and Ce^{140} was reinvestigated. Using a coincidence circuit having a resolving time of $\tau = 10$ nsec, the gamma rays in coincidence with a given gamma ray, as seen by a single counter, were displayed on a multichannel analyzer. Analysis of the intensity of the lines in the coincidence spectrum was made with the help of many calibration lines and a least-squares reduction technique using an electronic computer. In Ce^{140} the following coincidences were investigated: 923–1597, 815–1597, 487–1597, 329–1597, and 329–487 kev. In La^{140} the coincidence 162–304 kev was investigated. A discussion of the data in light of the disintegration schemes is given. (auth)

41956 LIFETIME OF THE SECOND EXCITED LEVELS IN Ni^{60} AND Ti^{46}. Y. K. Lee and C. S. Wu (Columbia Univ., New York). Phys. Rev., 132: 1200-5(Nov. 1, 1963).

The lifetime of the second excited levels in Ni^{60} and Ti^{46} was measured by beta-gamma delayed coincidence method employing a time-to-amplitude converter. The centroid shift of the beta-gamma delayed time distribution was measured with respect to the prompt time distribution due to a prompt gamma-gamma cascade that is present in each isotope. Simultaneous accumulation of the delayed and prompt time distribution on a split memory of a multichannel analyzer was made possible by the use of a third sorting detector. An upper limit of 5×10^{-12} sec was established for the mean life of both Ni^{60} and Ti^{46}. The mean life of the first excited state of Pb^{207} was also measured to be $(1.60 \pm 0.1) \times 10^{-10}$ sec from the slope of the delayed time distribution. (auth)

41957 MEAN LIVES OF THE FIRST TWO EXCITED STATES OF P^{31}. René J. A. Levesque (Univ. of Montreal), C. P. Swain, and V. K. Rasmussen. Phys. Rev., 132: 1205-10(Nov. 1, 1963).

Nuclear resonance fluorescence techniques were used to measure the mean lives of the first and second excited states of P^{31}. The exciting γ radiation was obtained by bombarding 99.999% pure phosphorus with 4.0 and 4.95-Mev protons. Self-absorption of the 1.26-Mev resonant radiation gives $\tau = (7.16^{+1.3}_{-1.0}) \times 10^{-13}$ sec. Similarly, $\tau = (4.2^{+1.5}_{-1.0}) \times 10^{-13}$ sec is found for the 2.23-Mev level. The angular distribution for resonant scattering of the 2.23-Mev radiation is consistent with the expected pure quadrupole nature of this $\frac{1}{2}-\frac{5}{2}-\frac{1}{2}$ transition. The angular distribution for resonant scattering by the 1.26-Mev level allows 4 values of the E2/M1 amplitude ratio, $\delta = -0.20 \pm 0.03$, -1.12 0.08, 0.90 ± 0.06, and 5 ± 0.8. Only $\delta = -0.20$ is consistent with the principal work of others on angular distributions and linear polarization. The lifetime combined with Coulomb-excitation results gives $|\delta| = 0.40$, which is not compatible with the angular distribution. (auth)

41958 NONELASTIC CROSS SECTIONS OF Pb^{206} AND Pb^{208} FOR 14-Mev NEUTRONS. Gergory M. Haas and Pablo L. Okhuysen (Louisiana State Univ., Baton Rouge). Phys. Rev., 132: 1211-12(Nov. 1, 1963).

Measurements of the nonelastic cross sections of Pb^{206}, Pb^{208}, Cu, and Bi for 14-Mev neutrons by the sphere transmission technique are reported. The results are as follows: Pb^{206}, 2.50 ± 0.05 b; Pb^{208}, 2.58 ± 0.09 b; Bi, 2.53 ± 0.05 b; Cu, 1.44 ± 0.03 b. The values for Pb^{206} and Pb^{208} were computed from the measured nonelastic cross sections of ordinary lead, 2.53 ± 0.05 b, and of radiogenic lead, 2.50 ± 0.04 b. The difference in the cross sections of Pb^{206} and Pb^{208} is much less than that predicted from the one-body alpha decay theory. (auth)

41959 SENIORITY SELECTION RULES OF MAGNETIC DIPOLE TRANSITIONS AND ALLOWED BETA DECAY IN $1f_{7/2}$ NUCLEI. C. Noack (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev., 132: 1213-16(Nov. 1, 1963).

Matrix elements of one-body rank-one tensor operators exhibit seniority selection rules between states of a nuclear j^n configuration. These are given and their influence on β decays and M1 transitions in the nuclear $1f_{7/2}$ shell is discussed. (auth)

41960 NOTE ON THE DECAY OF ^{132}I. J. H. Hamilton, P. F. A. Goudsmit, and J. F. W. Jansen (Instituut voor Kernphysisch Onderzoek, Amsterdam). Physica, 29: 885-8(Aug. 1963).

Selected regions of the internal conversion electron spectrum in the decay of I^{132} were measured with high resolution in an iron-free double focusing spectrometer. K conversion electrons were measured for the following transitions: 147.2 ± 0.2, 620.6 ± 0.5, 630.0 ± 0.4, 650.2 ± 0.4, 652.1 ± 0.4, 667.8 ± 0.3, 669.7 ± 0.3, 671.5 ± 0.3, 772.9 ± 0.4, and 954.4 ± 0.5 kev. The 147.2, 620.6, 650.2, and 669.7 transitions were not reported previously. A possible interpretation of the position of the two doublet transitions at 650 and 670 kev is given. (auth)

41961 LEVELS IN ^{96}Mo. P. Born, W. H. Elsenaar, A. Veefkind, and J. Blok (Vrije Universiteit, Amsterdam). Physica, 29: 905-13(Aug. 1963).

Gamma rays following the decay of Tc^{96} and Nb^{96} were investigated with a scintillation spectrometer. Coincidence relations were established between some of them. Angular correlation measurements were performed that led to spins 5 for the 2730-kev level, 3 or 2 for the 2410-kev level and 2 or 3 for the 1950 and 1850-kev levels. Comparison was made with the models of Raz and Davydov and Chaban. (auth)

41962 QUASI-FREE PROTON-PROTON SCATTERING IN $Li^7(p,2p)He^6$ AND $Li^6(p,2p)He^5$. Toshinori Takemiya (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 30: 191-200(Aug. 1963).

The effect of the double scattering on the angular correlation distribution for the reactions $Li^7(p,2p)He^6$ and $Li^6(p,2p)He^5$ is investigated by means of the wave matrix developed by Lippmann. The calculation is made at an in-

cident proton energy of 155 Mev. It is shown that the double-scattering terms fill up the dip appearing in a simple impulse approximation and the two humps come closer. Use is made of a single-particle wave function for the p-shell proton in the target nucleus. The result fits well to the experiments for Li^7, but not for Li^6. (auth)

41963 THE TRANSFORMATION FACTOR FOR THERMAL TO 14 Mev NEUTRONS THROUGH Li^6D AND THE PRODUCTION OF A Li^6D-IRRADIATION CHANNEL. F. Baumgaertner (Technische Hochschule, Munich). Radiochim. Acta, 1: 222-5(Aug. 1963). (In German)

Fast reactions can be produced from thermal neutrons in a reactor by reactions with Li^6D by the reaction chain: $Li^6(n_{th},\alpha)T(D,\alpha)N_{14Mev}$. Calculations indicated that from a thermal neutron flux of $10^{17}n/cm^2sec$ a 14-Mev neutron flux of about $10^8n/cm^2sec$ could be achieved. A Li^6D irradiation channel was prepared and tested. The results confirmed the theoretical calculations. (M.C.G.)

41964 ON THE DECAY OF STATES IN Si^{28} EXCITED BY 1200-1320 kev PROTONS. Gerhard Wendt (Univ. of Helsinki). Soc. Sci. Fennica, Commentationes Phy. Math., 28, No. 8: 39p.(1963). (In English)

The 12.75, 12.80, 12.81, and 12.85 Mev resonance states in Si^{28}, corresponding to E_p = 1212, 1261, 1274, and 1315 kev, were investigated by measurement of spectra and angular distributions and correlations of gamma rays produced in the $Al^{27}(p,\gamma)Si^{28}$ reaction. The 12.75 and 12.80 Mev states are found to be 3^- states and the 12.85 Mev state a 4^+ state. The 12.81 Mev resonance state is likely to be a doublet state with both members excited by protons. The assignments of the states populated in the decay of these resonance states are discussed. The channel mixing parameters obtained are compared with those predicted by j + j and L + S coupling. Whether or not isobaric spin is a good quantum number in Si^{28} is discussed. (auth)

41965 PROPERTIES OF ELECTRIC QUADRUPOLE TRANSITIONS IN NUCLEI. D. K. Kaipov and A. N. Pertsev. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 71-8(1963). (In Russian)

Data on E-2 transitions were analyzed and correlated to the single-particle model. The results produced a sufficiently effective formula for calculating the half life of E-2 transition in even-even nuclei. The obtained emperical equations did not agree with a generalized single-particle model. An approximation correlation was found for the low-excitation half life and excitation energy of odd-even nuclei. Initial excitations in odd-even nuclei appear in the single particle model. (R.V.J.)

41966 ANALYSIS OF HIGH-ENERGY HELIUM ISOTOPES EMITTED IN PROTON REACTIONS WITH PHOTOEMULSION NUCLEI. V. A. Kobzev, Zh. S. Takibaev, E. V. Shalagina, and G. R. Shtern. Tr. Inst. Yadern. Fiz., Akad. Nauk Kaz. SSR, 6: 133-9(1963). (In Russian)

An analysis was made of high-energy helium fragments emitted in 9-Bev proton reactions with nuclear emulsions. In 5726 events 69 particles with Z = 2 and kinetic energies over 100 Mev were found. Tabulated data on doubly charged particles emitted from spallation at various kinetic energies showed that with larger E_k the cross sections diminish. The method for separating doubly and singly charged particles is described. The results confirmed the presence of high-energy (2000-Mev) doubly charged particles among the interaction products. The observed particles could not be assigned to a specific helium isotope. (R.V.J.)

41967 NUCLEAR SPIN RESONANCE. V. S. Grechishkin and N. E. Ainbinder. Usp. Fiz. Nauk, 80: 597-637 (Aug. 1963). (In Russian)

The first experiments on nuclear quadrupole interactions in crystals were carried out by R. V. Pound (Phys. Rev., 79: 685(1950)) who investigated the broadening of nuclear magnetic resonance lines and by H. G. Dehmelt and H. Krüger (Naturwiss., 37: 111(1950)) who observed the absorption of radiowaves in a neutral magnetic field. The work was subsequently continued in two directions: toward the study of large, constant quadrupole interactions and weak magnetic fields (nuclear quadrupole resonance); and strong magnetic fields and low quadrupole bonds (nuclear magnetic resonance, divided by quadrupole interactions). M. Bloom, L. Robinson, et al. (Can. J. Phys., 36: 1280, 1295(1958)) examined a special case in which the quadrupole and magnetic interactions were of the same order of magnitude; this was designated as the nuclear spin resonance. The problem and the published material are reviewed for energy levels in which the spins of the resonant nuclei are $^3/_2$ or $^5/_2$. Discovery of the Zeeman effect in the nuclear quadrupole resonance by H. Krüger (Z. Phys., 130: 371 (1951)) initiated studies on the splitting up of the energy levels. The theory and the temperature dependence of the constant quadrupole bond was developed by H. Bayer (Z. Phys., 130: 227(1951)) who studied the rotational vibration of the nuclei. The experimental techniques are described and the data obtained are tabulated for the following nuclei: Al^{27}, B^{11}, B^{10}, Be^9, Cs^{133}, Cu^{63}, Cu^{65}, D^2, K^{39}, K^{41}, Li^6, Li^7, N^{14}, Na^{23}, Nb^{93}, and Rb^{87}. (Review article, 131 references). (TTT)

41968 PARTICLE SEPARATION WITH SCINTILLATION COUNTERS AND USE IN THE MEASUREMENT OF PROTON SPECTRA FROM REACTIONS OF NEUTRONS IN THE ENERGY REGION 12 TO 22 Mev WITH THE NUCLEI K^{39}, I^{127}, AND Cs^{133}. R. Langkau (Physikalische Staatsinstitut, Hamburg). Z. Naturforsch., 18a: 914-26(Aug.-Sept. 1963). (In German)

The use of special scintillation-counter methods for particle discrimination for investigation of nuclear reactions of neutrons with K, I, and Cs is described. It is possible, using these measuring methods, to measure with good statistics the spectra of emitted charged particles in the presence of a strong gamma background. The energy distributions of protons, which were emitted in the bombardment of the scintillation crystals CsI(Tl) and KI(Tl) with neutrons, were measured. The crystals served therefore as target as well as detector. The energies of the neutrons, which were produced with the help of the $T(d,n)He^4$ reaction at deuteron energies of from 3 to 4.5 Mev, could be varied between 12 and 22 Mev by choice of the observation angle. From the energy spectra the effective cross section could be measured. An analysis of the spectra indicated that the statistical theory of the nuclear reactions probably cannot describe the circumstances in all instances and that direct exchange effects contribute considerably to the cross section. (tr-auth)

41969 MEASUREMENT OF THE LIFETIME OF THE 8.4-kev LEVEL OF Tm^{169}. D. Bloess and F. Muennich (Technische Hochschule, Brunswick). Z. Naturforsch., 18a: 1028-9(Aug.-Sept. 1963). (In German)

Because of previous discrepancies in results, measurements were made of the lifetime of the 8.4-kev state of Tm^{169}. An impulse-time spectra was measured and a half life value of 3.53 ± 0.20 nsec was obtained. (M.C.G.)

41970 CONDITION OF UNNORMAL PARITY OF N^{14}. Hans Georg Wahsweiler (Universität, Freiburg i. B.). Z. Physik, 175: 370-81(1963). (In German)

A conventional shell model calculation was made for some odd-parity states of N^{14} assuming them to arise from

the configurations p^9d and p^92s. The limit was studied especially for when the inequivalent particle is coupled in the jj-scheme to the p-shell configurations. Then a satisfactory picture can be given of the lowest 0^-, 0 and 3^-, 0 level, supposing that the well depth of the interaction potential between the outer particle and the p-shell is chosen properly. (auth)

41971 THE DECAY OF Gd^{151}. E. Steichele and P. P. Kienle (Technische Hochschule, Munich). Z. Physik, 175: 405-15(1963). (In German)

The electron-capture decay of Gd^{151} was investigated by means of γ and γ-γ coincidences using scintillation counters. Besides the known γ rays of 22, 154, 175, 244, and 308 kev, additional γ transitions with energies of 107 and 350 kev could be assigned to the decay of Gd^{151}. Gamma-gamma coincidence measurements showed the following cascade transitions: (107–244 kev), (154–175–22 kev), and (308–22 kev). The K-conversion-coefficients of several transitions were determined by comparing the γ intensities and the previously known conversion electron-intensities, using a direct measurement of the K-conversion-coefficient of the 175-kev transition by a delayed-coincidence experiment as a normalization of the relative intensities. With the available information a level-scheme for Eu^{151} is proposed. (auth)

41972 THE QUADRUPOLE MOMENT OF THE 8.42-kev LEVEL OF Tm^{169}. S. Huefner, M. Kalvius, P. Kienle, W. Wiedemann, and H. Eicher (Technische Hochschule, Munich). Z. Physik, 175: 416-21(1963). (In German)

The hyperfine interaction of the 8.42-kev level of Tm^{169} was investigated using the Mössbauer effect in thulium ethyl sulfate. The hyperfine-splitting was of pure quadrupole type; its temperature dependence between 6 and 250°K was measured. The spectroscopic quadrupole moment of the 8.42 kev level was determined as $Q = -(1.1 \pm 0.1)$ barn, leading to an intrinsic quadrupole moment of $Q_0 = +(5.5 \pm 0.5)$ barn. (auth)

41973 MEASUREMENT OF THE ANISOTROPY OF THE $\beta-\alpha$ ANGULAR DISTRIBUTION IN THE DECAY OF Li^8. G. Ischenko, D. Seyboth, and H. Wegener (Universitat Erlangen, Nuremberg). Z. Physik, 175: 422-9(1963). (In German)

The $\beta-\alpha$ angular correlation $W(\Theta) = 1 + a \cos \Theta + A \cos^2 \Theta$ of the decay of Li^8 was measured for average electron energies of $E_\beta \approx 5$, 11, and 12 Mev. The experiment yielded an anisotropy $A = (0.0036 \pm 0.0011) \cdot E_\beta\ (\text{Mev})^{-1}$. This result is in good agreement with the results of other groups. The measurements were performed in a counting chamber separated from the activation room simultaneously for two scalar positions $\Theta = 90$ and 180°. The result is discussed in terms of the CVC theory, taking into account the second forbidden Fermi-matrix elements ($||M_1||$) and ($||E_2||$). (auth)

41974 RESONANCE SCATTERING ON THE 15.1-Mev LEVEL OF C^{12}. H. Schmid and W. Scholz (Universitat, Freiburg i. B.). Z. Physik, 175: 430-9(1963). (In German)

The broad photon spectrum of the $Li^7(p,\gamma)Be^8$ reaction was used to excite the 15.1 Mev 1^+; 1 level in C^{12}. The integrated scattering cross section of 1.82 ± 0.12 Mev·mb was determined by measuring the resonantly scattered photons and the primary radiation with the same NaI crystal. The peak absorption cross section of 28.9 ± 3.3 barns was obtained by minimizing the error of the integrated scattering cross section as determined from experiments with scatterers of different thickness. These results combined to give 40.2 ± 5.2 ev for the ground state radiation width and 44.7 ± 10.3 ev for the total width of the level. These widths are somewhat lower than previous reported results. The sharp 17.6-Mev radiation of the $Li^7(p,\gamma)Be^8$ reaction was also used to measure elastic scattering cross sections for carbon, aluminum, cadmium, and lead to 1.0 ± 1.0, 16.1 ± 3.7, 2.2 ± 0.2, and 5.2 ± 0.5 mb respectively. (auth)

41975 CONTRIBUTIONS TO THE THEORY OF ALPHA-DECAY. H.-D. Zeh (Universität, Heidelberg). Z. Physik, 175: 490-505(1963).

The theory of α decay was reformulated in order to point out the necessary approximations in a rigorous way. The connection between the formulas given by Thomas and by Mang was easily established. Mang's explicit expressions of reduced widths, valid for shell model wave functions, were brought into a general form. The theory was applied to BCS wave functions and the decay constants of several Po isotopes were calculated as an example. Furthermore results are presented which favor a spin assignment $I = 18$ and a predominating $(h9/2)^2_8\ (i11/2)^2_{10}$ configuration for the Po^{212} isomeric state. The penetrabilities were calculated numerically, since the WKB-method was found to be unsatisfactory. (auth)

41976 THE KLL-AUGER SPECTRA OF IRON AND VANADIUM. Werner Mehlhorn and R. G. Albridge (Vanderbilt Univ., Nashville). Z. Physik, 175: 506-19(1963). (In German)

The relative intensities of the KLL-Auger transitions of Fe ($Z = 26$) and V ($Z = 23$) were measured with an iron free, double focusing β spectrometer. The results obtained were in good agreement with those measured by Sokolowski and Nordling for $Z = 29$ and $Z = 32$. This confirms the discrepancies between the nonrelativistically calculated intensities and the experimental values in the region of lower Z. A summary is given about all known measurements of the KLL-Auger intensities. Also the KLL:KLX-ratio of Fe was measured to be 1.0 (0.19 ± 0.01). The energy of the 14.4-kev γ transition of Fe^{57} was evaluated to be (14389 ± 6) ev. (auth)

41977 DETERMINATION OF THE MAGNETIC MOMENT OF THE 206-kev LEVEL OF Re^{187}. H. K. Walter, A. Weitsch, and P. Kienle (Technische Hochschule, Munich). Z. Physik, 175: 520-9(1963). (In German)

The half life of the 206-kev state of Re^{187} was determined with delayed coincidence technic to be: $T_{\frac{1}{2}} = (5.70 \pm 0.05) \times 10^{-7}$ sec. The rotation of the spin of the 206-kev state in a magnetic field was observed in a differential angular correlation measurement with the 480–72 kev γ-γ cascade. From the observed Larmor frequency a magnetic moment of $\mu = (5.02 \pm 0.06)\mu_K$ for the 206-kev level was derived. The 480–72 kev γ-γ angular correlation was found to be undisturbed in an aqueous solution of ammonium tungstate. (auth)

41978 DETERMINATION OF THE ELECTRIC NUCLEAR QUADRUPOLE MOMENT OF ODD STABLE STRONTIUM-87 NUCLEUS. Gisbert zu Putlitz (Universität, Heidelberg). Z. Physik, 175: 543-52(1963). (In German)

In order to determine the electric quadrupole moment of Sr^{87} ($I = 9/2$) the hyperfine structure splitting of the 5s 5p $^3P_1$-state of the Sr I spectra was investigated by optical double resonance. By detection of high-frequency transitions ($\Delta F = \pm 1$, $\Delta m_F = 0, \pm 1$) in an external magnetic field $H_0 \approx 0$ hyperfine structure separations of 1463.149(6) and 1130.264(6) Mc/sec were obtained. From these frequencies the magnetic hyperfine structure splitting constant

A = −260,084(2) Mc/sec and the electric quadrupole interaction constant B = −35,658(6) Mc/sec were calculated. B led to an electric quadrupole moment of $Q(Sr^{87}) = +0.36(3) \times 10^{-24}$ cm^2. (auth)

41979 ANGULAR DISTRIBUTION OF PHOTONEUTRONS FROM Bi^{209}. E. S. Anashkina (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 45: 404-6(Sept. 1963). (In Russian)

Angular distributions are obtained for 1.5 to 4.0 and 4.0 to 11.5-Mev photoneutrons emitted from Bi^{209} irradiated by bremsstrahlung with maximum energy of 85 Mev. The neutrons are registered with NIKFI–Ya2 photographic emulsions 400 μ thick. The contribution of the anisotropically distributed part to the total photoneutron yield is ~20%. In absolute units the total photoneutron yield for energies between 1.5 and 11.5 Mev is $(3.7 \pm 0.8) \cdot 10^{-3}$ neutrons/mole·Mev·cm^{-2}. (auth)

41980 EFFECT OF THE NUCLEUS ON π^0-MESON PRODUCTION. V. S. Demidov, E. D. Zhizhin, V. G. Kirillov-Ugruimov, A. K. Ponosov, F. M. Sergeev, and Ya. Ya. Shalamov (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR and Moscow Inst. of Engineering Physics). Zh. Eksperim. i Teor. Fiz., 45: 437-42(Sept. 1963). (In Russian)

Production of mesons(π^0) in collisions between 2.8 BeV/c-mesons(π) and light nuclei (C, Cl, F) or xenon ions is investigated. The angular distributions obtained are compared with data on meson(π^0) production on free and quasi-free nucleons at the same primary energy. The differences observed can be explained as a result of the effect of the nucleus as a whole. (auth)

41981 RESONANCE SCATTERING OF γ-RAYS FROM LIQUID AND SOLID SOURCES OF Sn^{116} AND Cu^{65} NUCLEI. D. K. Kaipov, Yu. K. Shubnyi, Yu. G. Kosyak, and R. B. Begzhanov (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR and Inst. of Nuclear Physics, Academy of Sciiences, Uzbek SSR). Zh. Eksperim. i Teor. Fiz., 45: 443-7 (Sept. 1963). (In Russian)

Resonance scattering of 1.29 and 1.114-Mev γ rays from liquid and solid In^{116} and Ni^{65} sources on Sn^{116} and Cu^{65} nuclei is investigated. For liquids the effect decreases by 0.055 and 0.040 and for solid sources by 0.050 and 0.024, respectively, for Sn^{116} and Cu^{65}. (auth)

41982 DECAY OF RESIDUAL NUCLEI PRODUCED IN THE INTERACTION OF 660-Mev PROTONS WITH CARBON NUCLEI. Z. P. Zhdanov and P. I. Fedotov. Zh. Eksperim. i Teor. Fiz., 45: 455-9(Sept. 1963). (In Russian)

Experimental and calculated excitation yields and energies of residual nuclei produced after termination of the cascade process in the C^{12} nucleus are presented. Decay of residual nuclei is considered under the assumption that the frequencies of occurrence of various final states are proportional to their statistical weights. The calculations satisfactorily agree with the experiments. (auth)

41983 LIFETIME OF THE 0.570-Mev LEVEL IN THE Te^{122} NUCLEUS. Yu. K. Shubnyi (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Zh. Eksperim. i Teor. Fiz., 45: 460-3(Sept. 1963). (In Russian)

The lifetime of the first excited state of the Te^{122} nucleus with an energy 0.570 Mev is measured by applying the nuclear resonance scattering method in which gaseous Sb^{122} in the SbH^3 compound is employed. The value $\tau_\gamma = (1.20 \pm 0.30) \cdot 10^{-11}$ sec is obtained for the lifetime of the level. Vibrational parameters are computed for even-even Te nuclei. (auth)

41984 INVESTIGATION OF THE γ-RADIATION FROM Cs^{140}. E. A. Zherebin, A. I. Krylov, V. I. Polikarpov, and N. N. Yuzvuk. Zh. Eksperim. i Teor. Fiz., 45: 464-8 (Sept. 1963). (In Russian)

The method and the results of investigation of the γ rays from the short-lived fragment Cs^{140} ($T_{1/2}$ = 66 sec) are described. A gas loop on the reactor was employed for transferring the Xe and Kr to the measurement site and for enriching the decay products with the investigated fragment. Investigation of Cs^{140} was carried out by express chemical extraction of cesium. As a result the following lines were observed in the γ radiation of Cs^{140}: 0.59 ± 0.01; 0.88; 1.14; 1.62; 1.85; 2.06; 2.32; 2.72; and 3.15-Mev. (auth)

41985 THEORY OF PHOTODISINTEGRATION OF LIGHT NUCLEI WITH EMISSION OF FAST DEUTERONS. V. V. Balashov and V. N. Fetisov (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 45: 532-40(Sept. 1963). (In Russian)

A characteristic feature of the (γ, d) reaction — the shift of the threshold for fast deuteron emission — is examined within the framework of the shell model of light nuclei. (auth)

41986 ON A CERTAIN EXPERIMENTAL POSSIBILITY OF STUDYING THE MECHANISM OF THE (t,d) REACTION. V. V. Balashov (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 45: 541-3(Sept. 1963). (In Russian)

Excitation of $^5/_2^-$ levels (at 7.47 Mev and in the region of 5–6 Mev) in the $Li^6(t,d)Li^{7*}$ reaction is considered. It is shown that due to the strong structure selection rules established for neutron and triton reduced widths, the relative probability for excitation of these levels depends on the ratio of the contributions from the stripping and knock-out mechanisms. Thus by studying the excitation spectrum of the Li^7 nucleus in the $Li^6(t,d)Li^7$ reaction one can derive information on the relative contributions of these mechanisms. (auth)

41987 SLOW π^+-MESON CAPTURE BY LIGHT NUCLEI IN THE CORRELATIONAL NUCLEAR MODEL. G. M. Shklyarevskii (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 45: 698-705 (Sept. 1963). (In Russian)

Absorption of slow π^+-mesons by light nuclei in the $\pi^+ + A \rightarrow A' + 2p$ reaction is considered. It is shown that an investigation of the proton spectra permits one to study small range pair correlation between nuclear nucleons. Conditions in which the corresponding experiments should be carried out are indicated. (auth)

41988 PROGRESS IN FAST NEUTRON PHYSICS. G. C. Phillips, J. B. Marion, and J. R. Risser, eds. Rice University Semicentennial Series. Chicago, University of Chicago Press, 1963. 407p. $8.50.

Of the twenty-two invited papers presented, four were previously abstracted for NSA. Five contributed short papers are also included because of their recent contributions to the field. These papers are, however, not included in NSA; they include neutron thresholds at tandem energies, neutron scattering from U^{238}, excitation of the 7.65-Mev level in C^{12}, Hauser-Teshbach calculations, and production of a polarized He^3 ion beam. The invited papers not included for NSA are basically historical. (R.E.U.)

41989 CONTINUOUS NEUTRON SPECTRA FROM LIGHT NUCLEI. C. H. Poppe (Univ. of Minnesota, Minneapolis). p.51-60 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

Continuous neutron spectra were observed in reactions involving light nuclei where only a few widely spaced nuclear levels are involved. These spectra are a result of

reactions in which three or more particles occur in the final state. The deuteron bombardment of He^4 and of hydrogen isotopes is discussed. (R.E.U.)

41990 FEW-NUCLEON PROBLEMS. I. Slaus (Institut "Rudjer Boskovic," Zagreb). p.61-72 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

The data on nucleon-nucleon scattering and the information derived from the study of nuclear structure indicate that nuclear forces are to a large extent charge independent. However, the difference between neutron-proton and proton-proton ^1S scattering length together with the discrepancy between the coupling constants G_v for the beta decay and G_μ for the muon decay and the difference among the energy levels of the lowest T = 1 multiplets after allowing for Coulomb effects and the n-H mass difference could be considered as evidence for a small charge dependence. It is concluded that the evidence based on the difference between coupling constants G_v-G_μ and the energy levels of T = 1 multiplets is not conclusive, since the arguments are subject to large uncertainties arising from inadequate knowledge of the nuclear structure. The evidence based on the difference between the scattering lengths, though subject to uncertainties (since the experimental value for a_{pp} must be corrected for Coulomb effects), is more conclusive. The discrepancy between a_{np} and a_{pp} cannot be explained by the magnetic interaction, as has been suggested earlier. (auth)

41991 INELASTIC NEUTRON SCATTERING, SPECTRA, AND ANGULAR DISTRIBUTIONS. Lawrence Cranberg (Los Alamos Scientific Lab., N. Mex.). p.89-110 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

Data are presented that illustrate systematic features of the results and at the same time indicate the present state of experimental techniques in neutron inelastic scattering. Energy resolution is discussed in its application to the determination of nuclear energy states in nuclei. A review is presented of research in scattering at neutron energies of less than 4 to a high of 14 Mev on various heavy nuclei. (R.E.U.)

41992 GAMMA RAYS FROM INELASTIC NEUTRON SCATTERING. R. B. Day (Los Alamos Scientific Lab., N. Mex.). p.111-44 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

A review is presented of the current state of experiments on the γ rays produced in neutron inelastic scattering. Recent work, both published and unpublished, is summarized. The implications of the Hauser-Feshbach theory as a tool in determining the properties of excited states of nuclei are discussed. Types of experiments presented include measurements of γ-ray spectra and differential cross sections, angular distributions, gamma-gamma coincidence measurements, neutron-gamma angular correlations, possibilities of internally converted electrons, and lifetime measurements of metastable states. Experimental techniques and results are presented. (R.E.U.)

41993 REACTIONS PRODUCED BY 14-Mev NEUTRONS. L. Colli (CISE Labs., Milan). p.145-72 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

A discussion is presented on the two types of interactions obtained with 14 Mev neutrons. The extent to which these mechanisms are understood is presented. The direct interaction and the compound nucleus formation mechanisms are discussed appropriately for the reactions (n,d), (n,p), and (n,α) on various nuclei. (R.E.U.)

41994 COUNTER TECHNIQUES FOR THE STUDY OF NEUTRON INDUCED REACTIONS. G. Dearnaley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.173-92 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

Recent developments in the fields of neutron spectrometry, flux measurements, and reaction processes following the development of semiconductor detectors are discussed. Neutron induced reactions in silicon receive the main attention here with two other reaction, He^3(n,p) and B^{10}(n,α), being considered because of their importance in neutron detection technique. (R.E.U.)

41995 NEUTRON RADIATIVE CAPTURE REACTIONS. J. H. Gibbons (Oak Ridge National Lab., Tenn.). p.193-212 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

Advances made during recent years in the study of radiative capture reactions are reviewed. Improvements and new techniques in detection devices are discussed with emphasis on the determination of capture cross sections, capture γ ray spectra, and applications to astrophysics. (R.E.U.)

41996 NEUTRON RESONANCE PHENOMENA. W. W. Havens, Jr. (Columbia Univ., New York). p.215-34 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

The gap in neutron cross section data as a function of energy between slow neutron spectroscopy and the lowest energy at which reliable data could be taken using fast neutron techniques was eliminated by the improvement of time-of-flight velocity selectors in slow neutron spectroscopy. Improvements and techniques associated with the Columbia University Synchrocyclotron Neutron Spectrometer are discussed and results are given of experiments on various elements. (R.E.U.)

41997 NEUTRON RESONANCE PHENOMENA. Henry W. Newson (Duke Univ., Durham, N. C.). p.235-55 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

Neutron resolution technique in the kev range is discussed. A windowless gas target is described in which temperatures of 10°K and pressures of $^1/_{10}$ mm Hg are obtained by using gaseous refrigerants. Resolution results are presented for several experiments. (R.E.U.)

41998 ANGULAR DISTRIBUTIONS OF NEUTRONS. A. Langsdorf, Jr. (Argonne National Lab., Ill.). p.257-72 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

The new edition of BNL-400, a compilation of angular distribution data from neutron scattering, is reviewed. Some techniques and problems associated with the measurements are discussed. (R.E.U.)

41999 NEUTRON SCATTERING STUDIES. Harvey B. Willard (Oak Ridge National Lab., Tenn.). p.273-88 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

A review is presented on the development of neutron resonance phenomena in the Mev region. The neutron as an important tool for probing the nucleus is discussed from the characteristic feature that the reactions or scattering proceed through only a few states of a well-defined compound system. (R.E.U.)

42000 STUDY OF NEUTRON POLARIZATION FROM REACTIONS. W. Haeberli (Univ. of Wisconsin, Madison). p.307-22 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

A summary is presented on the results of measurements of the degree of polarization of the neutrons from various neutron-producing reactions. The polarization is measured by scattering from light nuclei; the selection of the scatterer depends on the neutron energy. Polarization studies from the reactions (p,n) and (d,n) on light nuclei and hydrogen isotopes are presented. Sources are now known that cover the energy range at 0.2 to over 25 Mev. (R.E.U.)

42001 SOURCES FOR POLARIZED IONS. E. Baumgartner (Universitat, Basel). p.323-39 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

The methods of obtaining polarized-ion sources are reviewed. The description and detection of polarization is discussed. The principles of atomic beam sources are discussed—type of magnetic selection used, transitions induced by r-f signals, and some possibilities of turning the state of polarization to any direction in space. A survey of operating ion sources is presented. (R.E.U.)

42002 POLARIZED TARGETS. M. Borghini (CEN, Saclay, France). p.341-7 of "Progress in Fast Neutron Physics." Chicago, University of Chicago Press, 1963.

A survey of orientation methods and their use for producing targets is presented. Some experiments performed previously are discussed: capture of polarized slow neutrons by polarized heavy nuclei (In^{115}, Gd^{155}, Gd^{157}, Ho^{165}); induced fission of U^{235}; scattering of polarized protons at 20 Mev by polarized protons; scattering of α particles at 6.53 and 7.33 Mev by polarized He^3; scattering of π^+ particles at 250 Mev by polarized protons. Generally, static methods are used with low heating beams to orient some medium and heavy nuclei. (R.E.U.)

42003 THE OPTICAL MODEL IN NUCLEAR AND PARTICLE PHYSICS. P. B. Jones. Interscience Tracts on Physics and Astronomy. New York and London, Interscience Publishers, 1963. 123p.

The principles of the optical model of the nucleus are outlined. Giant resonances and the measurement of nuclear size are discussed. Derivations of the model based on expansions of the scattering amplitude in powers of the strength of the nucleon-nucleon potential and on the dispersion formalisms for nuclear and potential scattering are developed. The model is discussed for intermediate and high nucleon energies, and the determination of nuclear structure is considered. (C.E.S.)

42004 ON THE DECAY OF 3.5 MIN. $_{53}I^{122}$. S. Jha (Carnegie Inst. of Tech., Pittsburgh). 21p. (CONF-275-2)

From American Physical Society 1962 Spring Meeting, Washington, D. C., Apr. 1962.

Scintillation spectrometer studies of the radiations from I^{122} have shown 564(100), 686(7), 780(5), 1250(1.1), 1420(0.9), 1750(2), 2180(1), 2540(0.2), 2740, 2920, 3170, and 3450 kev gamma rays with the intensities given in the parenthesis. From the gamma-gamma coincidence, positron-gamma coincidence, and the summing technique, it is inferred that some of these levels in Te^{122} are excited in the decay of I^{122}. From the gamma-gamma angular correlation studies, the 1350-kev level is assigned the spin and parity 0^+. The log ft values of the positron decay to the ground, 564, 1250, and 1340 kev states of Te^{122} were estimated to be 4.6, 5.1, 6.2, and 6.2 respectively. The log ft value of the β^- decay of Sb^{122} to the 1350-kev level of Te^{122} was estimated to be ≥ 9.7. (auth)

42005 HIGH SPIN RESONANCES IN $C^{12}(C^{12},\alpha)Ne^{20}$. E. Almqvist, J. A. Kuehner, E. Vogt, D. McPherson, and J. D. Prentice. 18p. (CONF-62-16)

From 3rd Conference on Reactions Between Complex Nuclei, Asilomar, Calif., Apr. 1963.

Measurements were carried out on the reaction $C^{12}(C^{12},\alpha)Ne^{20}$ for the ground state and 1.63 Mev state in Ne^{20} with an energy resolution of ~30 kev in the center-of-mass system over the energy range 10.3 to 12.8 Mev. Prominent resonance structure ≈150 kev wide is seen. The implications of these data on the average spacing and width of spin 8 levels in Mg^{24} at ~25 Mev excitation are discussed. The measured average cross sections for the α_0 (ground state) and α_1 (1.63 Mev state) channels of 21 mb and 69 mb respectively are somewhat larger than the calculated (compound nucleus model) values of 16 and 39 mb respectively. The calculated values become even smaller if the residual nuclei Na^{23} and Mg^{23} have an unusual number of high spin levels. In addition, detailed angular distributions of α_0 (ground state reaction) made in the energy range 10.45 to 11.5 Mev were analyzed to yield the average partial cross section for $l = 8$ collisions to be 12 mb as compared with the calculated value of 9.4 mb. (auth)

42006 USE OF OSCILLATION TECHNIQUE TO MEASURE EFFECTIVE CROSS-SECTIONS OF FISSIONABLE SAMPLES IN CRITICAL ASSEMBLIES. R. Vidal, O. Trediakoff, and M. Robin (Centre d'Études Nucléaires, Fontenay-aux-Roses, France). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/64, 43p. (CONF-133-14). (In French)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

The technique used to measure the effective absorption and neutron-yield cross sections of a fissionable sample is described. The 2 values are determined by analyzing the signals due to the variation in reactivity (overall signal) and the local perturbation in the flux (local signal) produced by the oscillating sample. The signals are standardized by means of a set of samples containing known quantities of fissionable material (U^{235}) and an absorber (B). The measurements are made for different neutron spectra characterized by lattice parameters, which constitute the central zone within which the sample moves. This technique is used to study the effective cross sections of U-Pu alloys for different heavy-water and graphite lattices in the Minerve and Marius critical assemblies. The same experiments are carried out on fuel samples of different irradiations in order to determine the evolution of effective cross sections as a function of the spectrum and the irradiations. (auth)

42007 MEASUREMENT OF THE RATIO OF FISSIONS IN U^{238} TO FISSIONS IN U^{235} USING 1.60 Mev GAMMA RAYS OF THE FISSION PRODUCT La^{140}. J. R. Wolberg, T. J. Thompson, and I. Kaplan (Israel Inst. of Tech., Haifa). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/46, 17p. (CONF-133-27)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

A method for measuring δ_{28}, the ratio of fissions in U^{238} to fissions in U^{235}, is described. The method avoids the need for a fission chamber calibration and is accomplished directly with foils irradiated within a fuel rod in the lattice. Two foils of differing U^{235} concentration are irradiated and allowed to cool for at least a week. The relative activities of the 1.60 Mev γ rays of the fission product La^{140} are determined for the 2 foils. This ratio, the foil weights and atomic densities, and the ratio of fission yields β_{25}/β_{28} for La^{140} are then used to determine δ_{28}. This value of δ_{28} is used to calibrate simpler measurements in which the rela-

tive γ activities above 0.72 Mev are determined for sets of foils irradiated in fuel rods of the lattices of interest. The method appears to offer the advantages of direct measurement and increased accuracy (the major uncertainty being the ratio of β_{25}/β_{28} of La^{140}). The results can be improved as better fission-product yield ratio data become available, and the method facilitates comparison of δ_{28} values obtained by different laboratories. (M.P.G.)

Particle Accelerators

Refer also to abstract 41115.

42008 (CEA-2279) ETUDE DES OSCILLATIONS BETATRON DANS L'ACCELERATEUR A CHAMP FIXE ET A GRADIENT ALTERNE. (Study of Betatron Oscillations in a Constant Field of the Alternating Gradient Accelerator). Claude Lauzanne (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 135p.

Thesis submitted to Universite, Paris.

The conditions for the stability of a constant energy particle beam circulating in the magnetic field of the FFAG accelerator are studied. The equations for the equilibrium orbit, the low amplitude oscillations, and the amplitude stability limits of the beam are derived using approximation methods. The precision of the theoretical results were checked by computer calculations. The parameters were systematically varied to clarify the mechanism of the amplitude variations of the trajectories. For the radial sector model, the possibility of introducing magnetic field free zones is considered. The case of short straight sections, respecting the field periodicity, and that of long straight sections creating super-periods are also examined. Solutions that should lead to a practical machine are given for the two cases. (auth)

42009 (CEA-2303) ETUDE DES NEUTRONS DIFFUSES AUTOUR DU SYNCHROTRON SATURNE. (Study of the Neutrons Scattered Around the Saturne Synchrotron). P. Tardy-Joubert and H. de Kerviler (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 13p.

The fast neutron fluxes diffused around the proton synchrotron Saturne of Saclay and the average energy of neutrons were measured at distances from 25 to 700 m from accelerator's center. Experimental results are in very good agreement with diffusion theory of neutrons in an infinite medium in which the mean free path is 135 m. The results obtained may be used for the calculation of shielding around sources of accelerators emitting fast neutrons. (auth)

42010 (FA/WP/23/Rev.3) REPORT OF THE WORKING PARTY ON THE EUROPEAN HIGH-ENERGY ACCELERATOR PROGRAMME. (European Organization for Nuclear Research Geneva). June 12, 1963. 79p.

The conclusions of an examination of the structure and practicability of a program of large accelerator construction for Europe are presented. The bases (costs, needs, etc.) for the conclusions, and considerations (data processing, manpower, communications) associated with such a program, are discussed. (D.C.W.)

42011 (NIRL/R/43) R. F. BEAM LOADING IN NIMROD. G. H. Rees (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). Aug. 1963. 21p.

Numbers (r-f power dissipation, reactive cavity loading, etc.) obtained for beam loading in Nimrod indicate that the present r-f system has sufficient power to show whether its power level or space charge effects is the limiting factor in obtaining large beams. Two proposals for a higher power r-f system, using the present r-f cavity, are outlined. (auth)

42012 (NIRL/R/46) COMPUTER PROGRAM FOR PARTICLE TRACKING IN NIMROD. D. Whiteside (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). 1963. 14p.

The Fortran computer program Nimrod Dynamics is described. This program tracks particles through a magnetic field in cylindrical or cartesian coordinate systems using either coupled vertical and radial equations of motion or radial equations only. Program facilities include a flexible representation of the magnetic field, calculation of betatron frequencies, and a variety of printing modes. Quadrupole magnets may be incorporated into the machine. (auth)

42013 (NIRL/R/47) PARTICLE TRAJECTORIES FROM A NIMROD OCTANT. D. Whiteside (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). July 1963. 33p.

Results for charged particle trajectories from a target located inside a Harwell Synchrotron octant are presented in coordinates useful for designing secondary particle beam channels. Methods are given for deriving beam characteristics (angular acceptance, magnification, and momentum dispersion) that are required to predict the performance of beams. (auth)

42014 (NP-13185) MAGNETIC QUADRUPOLE DESIGN CONSIDERATIONS. A. C. Paul (California. Univ., Los Angeles). July 1963. Contract Nonr-233(44). 26p.

The design of a quadrupole lens based upon an ion optic study is considered in terms of a parameter ϕ for quadrupole lenses related to the magnetic field gradients and ampere-turns. Figures showing particle trajectories through a quadrupole doublet parameterized in terms of this dimensionless quantity ϕ are given. Since the desired trajectories are usually known, ϕ may be found directly from the figures and related to the current in the quadrupole for a given particle energy and a given quadrupole design. A Fortran program is included for calculating the matrix elements describing the particle trajectories. (auth)

42015 (SLAC-18) TWO-MILE ACCELERATOR PROJECT. Quarterly Status Report, April 1–June 30, 1963. (Stanford Univ., Calif. Stanford Linear Accelerator Center). Aug. 1963. Contract AT(04-3)-400. 26p.

Development of accelerator structures, klystrons, modulators, instrumentation, control systems, vacuum systems, and microwave components and systems is reported. Operations of the engineering branches and modification and operation of the Mark IV accelerator are described. Research on magnets, vacuum systems, beam equipment, health physics, shielding, and r-f particle separators is also summarized. (D.C.W.)

42016 THE WORK OF THE RUTHERFORD LABORATORY. T. G. Pickavance (National Inst. for Research in Nuclear Science, Chilton, Berks, Eng.). Brit. J. Appl. Phys., 14: 643-50(Oct. 1963).

The Rutherford Laboratory is principally concerned with two accelerators: a 50-Mev proton linear accelerator, which has been operating since 1960, and a 7-Bev proton synchroton (NIMROD) completed in the autumn of 1963. Both machines are freely available to universities for use in their own research programs. There is a great deal of

activity in development of the associated research apparatus; this is done in collaboration between the universities and the Laboratory, and is financed by the Laboratory. Through the Rutherford Laboratory the National Institute for Research in Nuclear Science enables universities to make full use of expensive research facilities that can only be provided centrally. (auth)

42017 NEW OBSERVATIONS OF X-RAY SPECTRA USING THE ORBITAL RADIATION FROM THE FRASCATI SYNCHROTRON. Yvette Cauchois, Christiane Bonnelle, and Guido Missoni. Compt. Rend., 257: 1242-4(Aug. 5, 1963). (In French)

The continuous spectra emitted by the electron beam in the Frascati synchrotron are studied at 5 to 14 Å, at a beam energy of 1.1 Bev. Absorption discontinuities and secondary emission spectra excited by the x radiation are observed. The K_α fluorescence doublet of Al at 8.3 Å is excited and photographed using a short exposure time. (tr-auth)

42018 THE ELECTRONIC SHUNT. J. Mech and W. Leonchick (Argonne National Lab., Ill.). Electron. Packaging Prod., 3: No. 1, 65(Jan. 1963). (TID-17629; UAC-6987)

A remotely controlled electronic shunt was developed for controlling the power supply to each of the 124 magnets in the Linac of the Zero Gradient Synchrotron. The shunt is a simple cascaded current amplifier, in which the control current is fed into a Type 2N553 transistor and then into a Type DA3F3 transistor, and finally into an output stage of four Type DA3F3 transistors in parallel. The overall gain of the shunt is 10^5, and hence a control current of 1 ma will control 100 amp in the output, compared with the maximum magnet current of 800 amp. The construction and installation of the shunt are described. (D.L.C.)

42019 WAVINESS MEASUREMENTS ON A CASCADE GENERATOR BY MEANS OF (p,γ) REACTIONS. A. Eckardt, G. Goetz, J. Mittenbacher, and R. Prager (Friedrich-Schiller-Universität, Jena, Ger.). Exptl. Tech. Physik, 11: 62-6(1963). (In German)

The per-unit-time analysis of the gamma intensity in (p,γ) reactions allowed a measurement of the undulating characteristics of the exit voltage of cascade generators. Moreover the method made possible an improvement of the energy resolving dissolvent power of the related acceleration arrangement. (tr-auth)

42020 ENERGY MEASUREMENTS ON THE BEAM OF THE CYCLOTRON AT THE ZENTRALINSTITUT FUR KERNPHYSIK IN ROSSENDORF. F. Baldeweg and K. Schlott (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Exptl. Tech. Physik, 11: 207-13(1963). (In German)

In order to determine the energy properties of the cyclotron beam, there are three problems: measurement of the mean energy and the energy half value weight of the proton, deuteron, and alpha particle beam; investigation of the dependence of both parameters on the deflector voltage, the dee voltage, and the frequency detuning with measurement of the time variation of the mean energy after switching in the machine; and reduction of the energy width of the beam. The principle of the measurements to determine the energy properties of the beam is described, and the results are given. Three methods are given for the reduction of the energy width of the beam. (J.S.R.)

42021 NUCLEAR EMULSION STUDIES OF BETATRON-EMITTED NEUTRON BACKGROUND AND ENERGY SPECTRA. B. M. Yakovlev and A. A. Yatis (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 4, 3-9(1963). (In Russian)

Measurements of fast neutron flux and energy distribution and evaluations of tissue equivalent doses indicated that with 24-Mev maximum bremsstrahlung the fast neutron flux is 6.38×10^4 n/cm^2 per r of γ radiation. The major part of the fast neutron flux was within the γ bremsstrahlung cone angle. (R.V.J.)

42022 ELECTRON CURRENT PULSE MONITOR FOR LINEAR ACCELERATORS. R. W. Dressel (New Mexico State Univ., University Park and White Sands Missile Range, N. Mex.). Nucl. Instr. Methods, 24: 61-5(July 1963). (In English)

A pickup loop suitably mounted inside the terminal drift tube of an electron linear accelerator receives an induced voltage pulse for each passage of an electron bunch without intercepting the beam. The resulting signal is detected in an external electrical network which may be arranged to present at its output terminals a voltage proportional to either the average pulse current or its integral over the pulse interval. Signal rise-time for current pulse operation is less than 0.4 μsec and typical sensitivity is 4.5 v/a. The monitor output is essentially electron-energy-independent although other related accelerator beam parameters affect the response slightly. (auth)

42023 SELFCORRECTION OF THE SATURATION EFFECTS AT PARTICLE ACCELERATORS. V. Bunea (Electric Machine Plant "Bucuresti", Bucharest). Nucl. Instr. Methods, 24: 74-6(July 1963). (In English)

A method is described and studied according to which the accelerator can self-correct the disadvantages of the saturation effects arising from the use of iron sheets in its construction. According to this method a winding put on the accelerator feeds a saturable reactance of relatively small size, specially calculated. (auth)

42024 LEADING A BEAM TO TARGET IN A SYNCHROCYCLOTRON BY MEANS OF STIMULATION BY AZIMUTHAL ASYMMETRIC MAGNETIC FIELD. K. P. Myznikov and I. N. Yalovoi (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 19-21(July-Aug. 1963). (In Russian)

A system for a synchrocyclotron that leads an accelerated beam to the target by means of stimulation by the first harmonic of an azimuthal asymmetric magnetic field is described. The disturbing field is created in the final acceleration cycle by a coil wound in each of four sectors of a circular magnet. The impulse current is produced in the coil by a capacitor bank that discharges at the required moment in the acceleration aycle. The system may be applied to the whole beam or a fraction of it. The beam strikes the target during the growth time of the impulse current. The maximum value of the impulse current does not exceed 200 amp. (tr-auth)

42025 MEASUREMENT OF THE MAGNETIC FIELD CHARACTERISTICS IN WEAK-FOCUSING SYNCHROCYCLOTRONS FOR ACCELERATION OF PARTICLE BEAMS. L. P. Zinovev, V. I. Kotov, and K. P. Myznikov (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 22-3(July-Aug. 1963). (In Russian)

A method for measuring the magnetic field characteristics for an accelerated beam of particles is presented. Formulas for the change in oribital radius of the particles as a function of field intensity are given. (tr-auth)

42026 SYSTEM FOR PRECISE REGULATION AND STABILIZATION OF ELECTRON ENERGIES IN BETA-

TRONS. N. N. Balamatov and B. A. Yurev (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 4, 24-7(July-Aug. 1963). (In Russian)

A system for regulating and stabilizing the electron energy for producing γ radiation of maximum energy from a 35-Mev betatron is described. The operation of the system, sources of instability, and their corrections are discussed in detail. The system provides stabilization of energy within ±10 kev. (tr-auth)

42027 MEASUREMENT OF THE ENERGY OF HEAVY IONS IN INTERNAL BEAMS OF CYCLOTRONS. Kh. Kekk, V. L. Mikheev, A. A. Pleve, and B. V. Fefilov (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 27-30(July-Aug. 1963). (In Russian)

A method for measuring the energies of ions inside a cyclotron with the aid of a silicon surface barrier detector is presented. The ions are scattered on thin foils at determined angles and registered together with the alpha particles of known energy. The amplitude of the received pulses are compared with the amplitudes of the pulses from the generator that are given in the preamplifier of the transistor, working in a magnetic field of ~18 k oersteds. From the correlations of the amplitudes the ion energy is determined within ±2%. (tr-auth)

42028 INJECTOR WITH HEATED CATHODE FOR CYCLIC ELECTRON ACCELERATORS. V. V. Ekivin (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 4, 30-2(July-Aug. 1963). (In Russian)

An injector with indirect heating of the cathode for a 35-Mev betatron is described. The injector is developed on the basis of the compressed cathode and has many applications. (tr-auth)

42029 PULSED SOURCE OF MULTICHARGED IONS. F. I. Mineev and O. F. Kovpik (Inst. of Engineering Physics, Academy of Sciences, Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 4, 33-8(July-Aug. 1963). (In Russian)

A pulsed source of multicharged ions with a cold cathode and oscillating electrons in the magnetic field of a heavy-ion linear acceleration is described. Axial extraction and effective plasma focusing is used for the separation of ions from the source. Ion currents obtained were 17 and 54 m amp for trivalent and divalent N^{14}, respectively, 30 mamp for divalent F^{19}, and 80 m amp for protons, accelerated up to 35 kev. (tr-auth)

42030 HIGH-POWER IMPULSE MODULATORS FOR H-F AMPLIFIERS AND AUTOGENERATORS WITH CUT-OFF. V. A. Borisov, G. N. Ostreiko, and V. S. Panacyuk, and L. I. Yudin. Pribory i Tekhn. Eksperim., No. 4, 83-5 (July-Aug. 1963). (In Russian)

Two types of systems for impulse modulation of h-f apparatus used as a voltage supply for accelerators are described. The modulators form a cut-off for use of partial discharge of capacitors. Gaseous discharge valves are adapted for use with the commutators. (tr-auth)

42031 VACUUM TECHNIQUES OF THE KARLSRUHE CYCLOTRON. A. Kuellmer (AEG-Forschungsinstitut, Frankfort am Main). Vakuum-Tech., 12: 37-40(Mar. 1963). (In German)

The special operating conditions are sketched which could result in the vacuum system of a cyclotron using a controllable magnetic field. The construction of the Cyclotron in Karlsruhe, producing 50-Mev deuterons, is described including details on the vacuum chamber, the pumping system, and its automatic pressure-dependent control device. The leakage rate was measured, and figures for the pressures obtained in the vacuum chamber are given. (auth)

42032 ON THE INFLUENCE OF INPUT TRANSITION ELECTROMAGNETIC FIELD CONFIGURATION ON ELECTRON DYNAMICS IN A GROUPING SECTION WITH CONSTANT WAVE PHASE VELOCITY. A. I. Zykov, E. K. Ostrovskii, and L. A. Makhnenko (Inst. of Physics and Tech., Khar'kov). Zh. Tekhn. Fiz., 33: 1066-9(Sept. 1963). (In Russian)

It is shown that a uniform accelerating field configuration is of great importance in the selection of congruent grouping transfer parameters for a system with constant wave velocity and comparably small electron injection energy (80 kev). With arbitrary selection of resonator transfer parameters based only on system congruency, the transfer parameters impose a certain influence on the character of electron phase mobility in the grouping system, resulting in reduced capture area. (R.V.J.)

42033 RADIATION BEAM WINDOW. Roy C. Marker and Sherman R. Farrell (to High Voltage Engineering Corp.). U. S. Patent 3,105,916. Oct. 1, 1963. Filed Sept. 8, 1960.

A beam window is described that can be used to hermetically separate two regions (e.g., the vacuum chamber of an accelerator and the irradiation target area at atmospheric pressure). The window is composed of two domed, parallel, gas-tight sheets having a space between them. A third dimpled or corrugated sheet is interposed between the first two as a means for maintaining a separation between the first two. The space between the two window sheets is used for the flow of a cooling fluid. (T.F.H.)

Plasma Physics and Thermonuclear Processes

42034 (AD-289568) ELECTRICAL AND PLASMA PHENOMENA ACCOMPANYING DETONATION. Final Report, October 1, 1961–September 30, 1962. R. T. Keyes (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Contract AF49(638)-1061. 19p.

Research progress on ionization and electrical conductivity and its relation to the deflagration to detonation transition in solid explosives, chemical reaction rates and the shock initiation of liquid explosive detonation, the mechanism of the flash-across phenomenon in the card-gap test for liquid explosives, and spectrography of external detonation-generated plasmas is reported. (D.C.W.)

42035 (AFCRL-62-502) A SURVEY OF THE THEORIES UNDERLYING THE MEASUREMENT OF PLASMA PARAMETERS. Scientific Report No. 1. Theodore J. Morin, Jr. and Giovanni Lanza (Northeastern Univ., Boston). June 5, 1962. Contracts AF19(604)-8462, AF49(638)-555, and AF19(604)-7358. 33p. (AD-288043)

Theories supporting various methods of measuring the more important characteristics of a plasma are surveyed. Microwave cavity, optical radiation, Stark broadening, and other methods are omitted. Single and duuble probe, dipole resonance, and visible interferometric measurements are described. It is concluded that as techniques become more refined the direction plasma diagnostics takes will be toward the more passive type optical measurements. (auth)

42036 (AFCRL-62-857) HEAT TRANSFER PROBE MEASUREMENTS AS A TECHNIQUE TO DEMONSTRATE MHD CONTAINMENT. Kenneth A. Rathjen (Massachusetts Inst. of Tech., Cambridge. Magnetogasdynamics Lab.). July 1962. Contract AF19(628)-221. 36p. (AD-288699)

A calorimeter-type gauge was constructed using a pair

of twisted number 44 formvar covered copper leads. The twisting minimized the induced voltage to a tolerable level (of the same order of magnitude as the heat transfer signal) provided the gauge was not in the presence of an ionized gas. The induced voltage was increased so much when a plasma was at or near the gauge that no conclusive evidence could be obtained regarding the question of total containment. It was observed that the heat transfer to the gauge was reduced by more than 80% when the magnetic field was applied. This conclusively showed that the plasma was at least partially contained. No conclusion could be drawn as to whether or not the total heat transfer to the gauge (when the magnetic field was applied) was due solely to the driver gas. (auth)

42037 (AFCRL-62-1093) NON-LINEAR PLASMA WAVES IN A STREAMING HOMOGENEOUS, COLD IONIZED MEDIUM. Scientific Report No. 175. O. E. H. Rydbeck (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Dec. 15, 1962. Contract AF19(604)-8012. 28p. (AD-292687)

The properties of nonlinear travelling and standing plasma waves in homogeneous, ionized cold streams are studied. For the travelling non-linear plasma waves it is possible to obtain direct and simple expressions that relate the charge density to the true stream coordinate. This direct method is not in general applicable to the practically important case of standing plasma waves—a symmetric space charge wave pair in the linear theory. There exists one exception, however, when the direct method can be applied to standing plasma waves—the very special case of stream plasma resonance. Provided there is no electronic overtaking, the indirect, but nevertheless exact, methods of Olving have to be used. The non-linear maximum charge peaks are shown to be rather similar for the physically otherwise quite different travelling and standing nonlinear waves. Both rapidly become very rich in harmonics as overtaking is approached. If such a stream runs through a multi-resonant system, an ionized anisotropic medium, or a series of cavities in a microwave device, high harmonics may be excited in the system. (auth)

42038 (ARL-63-105) TRANSIENT DISCHARGES IN WHIRL-STABILIZED ARCS. K. H. Hocker, M. Mailander, E. Pfender, H. Schrade, H. P. Streible, and W. Thielo (Stuttgart. Technische Hochschule. Institut für Hochtemperaturforschung). June 1963. Contract AF61(052)-590. 79p. (AD-415448)

Ohmic heating and stability of pulsed discharges were studied experimentally. In order to have reproducible conditions and defined geometry a predischarge representing a highly ionized plasma was used and described. The basic equations developed for the heating process and the main features of a model that permits their application to a cylindrical discharge are summarized. The impulse discharge is described in N as well as in H. As there is a quasi-stability in N but not in H—in accordance with theory—the experimental investigation of the N discharge gives definite results. The maximum temperature reached is about 80,000°K. Magnetic probes of very small dimensions suitable for investigation of short time phenomena in dense plasmas were developed. In addition, an apparatus was constructed that permitted injection of the probes into the discharge channel. The possible disturbance of the plasma channel was carefully studied. Temperature and current profiles of this discharge were obtained, as well as precise figures of the development with time. Diagnostics by short time spectroscopy was performed using the visible region as well as the UV and the vacuum UV. The results of the visible and UV-spectroscopy agree with the probe data. Concerning hydrogen heating, the discharge is highly instable. The reasons for this relative to N are revealed by theory. The way in which the discharge conditions should be altered to get a quasi-stable heating process that will give several hundred thousand degrees is discussed. (auth)

42039 (ARL-63-145) MAGNETO-PLASMADYNAMIC CHANNEL FLOW WITH HALL CURRENTS. James T. Yen and Charles L. Farn (North Carolina State Coll., Raleigh). Aug. 1963. Contract AF33(657)-8068. 47p.

Magnetoplasmadynamic channel flow with Hall currents is considered by using defined real parameters. The solutions obtained are found to be of a new type, different from the usual "Hartmann type" solutions. Several interesting conclusions are deduced. The solutions obtained are equivalent to those of Sherman and Sutton for certain conditions. Introducing complex parameters, Yen succeeded in greatly simplifying and extending the solutions to cover various cases of energy conversion. Three new functions found by Yen are tabulated. (auth)

42040 (ARL-63-166) ON ELECTRICAL CONDUCTION IN A NON-UNIFORM HELIUM PLASMA. A. Pytte and A. R. Williams (Dartmouth Coll., Hanover, N. H.). July 1963. Contract AF33(657)-8179. 27p.

A theoretical study was made of the plasma properties in the region close to a cylindrical cold anode surrounding a He arc plasma. The temperature profile of the heavy constituents (atoms, ions) is obtained from an Elenbaas-Heller equation. The electric field, the current density, the (elevated) electron temperatures and the electron density as functions of the distance from and the potential of the anode were calculated. A one-dimensional model is used, and a locally Maxwellian (about a drift velocity) electron distribution is assumed with the level of ionization determined by the Saha expression evaluated at the electron temperature. (auth)

42041 (AROD-2836:1) REFRACTIVE INDEX MEASUREMENTS IN A LABORATORY-PRODUCED PLASMA. Final Report. C. A. Plint (Oklahoma Univ., Norman. Research Inst.). Aug. 1963. Contract DA ARO(D) 31-124-G339. 23p. (AD-420268)

Theoretical aspects of determining the refractivity of a plasma (and therefrom its electron density) by observing changes in light beam deflection and reflection are discussed. Several methods are considered, and attempts to probe dense plasmas produced in an electrically driven linear shock tube by techniques based on changes in optical reflectivity of a glass-plasma interface are described. (D.C.W.)

42042 (ASD-TDR-63-41) NEGATIVE ION BEAM NEUTRALIZATION. Quarterly Technical Progress Report No. 2, February 9, 1963—May 9, 1963. (Ion Physics Corp., Burlington, Mass.). Sept. 1963. Contract AF08 (635)-3079. 45p.

The experimental apparatus set up to determine beam fractions of positive and negative hydrogen ions and neutral hydrogen atoms that result from the collisional interaction of 1—3 Mev negative hydrogen ions with a rare gas target is analyzed. A preliminary analysis is made of the relativistic distribution function for a charged particle beam by the use of the Boltzmann equation. The magnet systems, counting system, and calibration of the gas pressure gage are described. (auth)

42043 (CEA-2294) MOUVEMENT STOCHASTIQUE D'UNE PARTICULE CHARGEE DANS UN PLASMA.

(Stochastic Movement of a Charged Particle in a Plasma). I. Fidone, Ch. Lafleur, and S. Lafleur (European Atomic Energy Community and France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Fontenay-aux-Roses). 1963. 24p.

The stochastic movement of a charged particle in an ionized medium, with and without a magnetic field is studied using an equation of the Langevin type for the case where the auto-correlation of the fluctuating force is not singular. (auth)

42044 (CEA-2319) INFLUENCE DE LA FORME DE L'AXE MAGNETIQUE SUR LES PLAGES DE STABILITE ET LEUR VARIATION. (Influence of the Form of the Magnetic Axis on the Regions of Stability and Their Variations). C. Mercier and H. Tasso (European Atomic Energy Community and France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Fontenay-aux-Roses). 1963. 31p.

A study of many cases of plane and twisted magnetic axes shows that for a set of regular magnetic axis tending to racetrack limit, the stability regions tend rapidly to the racetrack stability. But, for the case of two axes apparently not very far apart, it is found that the corresponding regions of stability may be sometimes sensibly different. (auth)

42045 (D1-82-0263) *ON THE PLASMA ČERENKOV RADIATION. Richard Gerwin and Ralph Guernsey (Boeing Scientific Research Labs., Seattle). July 1963. 130p.

The Cherenkov radiation of longitudinal electric waves by a charge moving through a collisionless electron plasma with a velocity surpassing the electron thermal speed is treated. Transients effects and the effects of finite projectile size are examined. (D.C.W.)

42046 (D1-82-0273) COLLISION-INDUCED INSTABILITY IN A PLASMA WITH AN ISOTROPIC VELOCITY-SPACE DISTRIBUTION. J. E. Drummond, D. J. Nelson (Boeing Scientific Research Labs., Seattle); and J. L. Hirshfield (Yale Univ., New Haven). [1963]. Contract AF19(628)-2448. 17p.

A dispersion law for the propagation of longitudinal and transverse waves in an electron plasma is derived using the Boltzmann equation with a collision term representative of isotropic, recoilless, elastic, binary scattering of the electrons. For a spatially homogeneous plasma, the unperturbed velocity-space distribution is thus isotropic. Taking a collision frequency, ν, which varies with speed v as $\nu(v) = \text{const.} \cdot v^h$, a class of collision-induced instabilities can arise if $-3 > h > +3$. The growth rate of these instabilities is largest for an infinite wavelength perturbation. The results for transverse waves agree with an earlier derivation that used the relaxation approximation to describe the collisions. (auth)

42047 (D1-82-0283) MEASUREMENTS OF THE INTERNAL MAGNETIC FIELD ASSOCIATED WITH THE SUPERCRITICAL OPERATION OF THE POSITIVE COLUMN. Roy R. Johnson (Boeing Scientific Research Labs., Seattle). July 1963. 18p.

The helical instability of the positive column in a longitudinal magnetic field was observed by measuring the internal magnetic field of the positive column. The measurements were performed in helium with discharge tubes that had radii of 2.35, 3.54, and 4.75 cm and lengths of 1.37 m. The measurements of the internal magnetic field of the positive column were made as a function of applied magnetic field, gas pressure, and d-c discharge current. It was found that there was good agreement between these results and the theory of the helical instability of the positive column in a longitudinal magnetic field. (auth)

42048 (DCAS-TDR-62-167) EXPERIMENTAL MAGNETOHYDRODYNAMIC TURBULENCE INVESTIGATIONS. E. B. Turner (Aerospace Corp. Physical Research Lab., El Segundo, Calif.). Aug. 16, 1962. Contract AF04(695)-69. 21p. (TDR-69(2230-14)TR-1; AD-296526)

Previous investigations of MHD turbulence are reviewed briefly, and a short description of the apparatus, a stabilized linear pinch device, is presented. Improvements in the frequency response of the magnetic probes and RC integrators and modifications to the design of the high-pass filters are discussed. The following experimental results obtained are presented: autocorrelation measurements were performed on a set of Kerr cell photographs of the pinch to determine the wavelength of the instabilities; promising results were obtained using an x-y oscilloscope to determine the degree of correlation between signals from magnetic probes separated by varying distances; Alfven wave propagation of the magnetic field fluctuations was observed by the phase shift between two probe signals; some analyses were made of the rms values of B and its first and 2nd derivatives to t, and the maximum frequency of the turbulence was determined; and high-quality Kerr cell photographs of the pinch were taken on color film, using a new Kerr cell with a fluid that transmits the entire visible spectrum. The need for automatic data reduction techniques and for digital computer processing of data is also discussed. (auth)

42049 (ESD-TDR-62-249) SCATTERING FROM DENSITY FLUCTUATIONS IN A PLASMA (SCATTERING AND ABSORPTION CROSS SECTION). Technical Report No. 284. M. S. Macrakis (Massachusetts Inst. of Tech., Lexington. Lincoln Lab.). Oct. 22, 1962. Contract AF19(628)-500. 15p. (AD-291779)

It is shown that the absorption cross section in addition to the scattering cross section must be considered in scattering of coherent electromagnetic waves from density fluctations in a plasma. The formulation of the problem follows two different but equivalent methods. One method depends on the connection between the scattering cross section and the imaginary part of the index of refraction. The second method depends on the use of Boltzmann's equation for the description of a plasma in terms of a dielectric with spatial dispersion and external charges and currents. (auth)

42050 (LADC-5601) EXTERNAL PROBE MEASUREMENT OF THE PLASMA MAGNETIC FIELD IN THE SCYLLA I THETA PINCH. F. C. Jahoda and G. A. Sawyer (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-eng-36. 6p.

External magnetic probe measurements of the magnetic field inside the plasma verify that without a probe immersed in the plasma the external magnetic field is excluded throughout the second half-cycle of the driving magnetic field and that the breakthrough observed with a probe immersed in the plasma is due to the probe. (D.C.W.)

42051 (NP-13104) DVIZHENIE OTDEL'NYKH ZARYAZHENNYKH CHASTITS V MAGNITNOM POLE S VINTOVOI SIMMETRIEI. (Motion of Charged Particles in Magnetic Field with Helicoidal Symmetty). V. M. Balebanov, B. I. Volkov, et al. (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii and Moscow State Univ.). 1963. 27p.

A drift theory and numerical equation integration were used in an investigation of charged particle motion in a

right helical magnetic field. High velocity drift and grooved plasma instability were analyzed. It is shown that drift magnitude is determined by the injection point in relation to the separatrix and field parameters. An optimum injection point from the point of view of drift and particle confinement in was found near the separatrix maximum, at Larmor radii comparable to the separatrix radius. The injection angle for efficient drift is very narrow. A stable drift is produced by particle injection outside the separatrix with a field center rising at an arbitary azimuth. (R.V.J.)

42052 (NP-13110) UDERZHANIE ZARYAZHENNOI CHASTITSY KVAZISTATSIONARNYM VRASHCHAYUSHCHIMSYA POLEM MERIODIONAL'NYKH TOKOV, TEKUSHCHIKH PO SFERE. (Charged Particle Capture by Quasi-stationary Field of Meridian Currents Streaming in A Sphere). V. N. Starkova (Akademiya Nauk S.S.S.R. Radiotekhnicheskii Institut). 1962. 15p.

Equilibrium and stability of ideally conducting plasma current in a rotating spherical magnetic field was previously examined. Electric field distribution on the space between the current surface and the plasma and the behavior of charged particles emitted from an equilibrium cluster were investigated. Conditions and formulas for slow electron capture in the system were developed. (R.V.J.)

42053 (PIBMRI-1025-62) MAGNETOHYDRODYNAMIC STABILITY OF A TOROIDAL PLASMA STRUCTURE. Jeffrey Freidberg (Brooklyn. Polytechnic Inst. Microwave Research Inst.). May 10, 1962. Contract AF30(602)-2149. 42p. (RADC-TDR-62-284; AD-287912)

The macroscopic behavior of an infinitely long toroidal plasma structure of the type used in an ideal plasma switch is investigated. The plasma trajectory of an infinitesimally thin plasma with the geometric form of a right circular cylinder is described, and the stability of certain general geometric configurations is examined. It is shown that a plasma of infinitesimal thickness with the form of a right circular cylinder of arbitrary cross section always has a position of stable configuration and that the plasma cylinder will remain stable if it maintains a constant rotational velocity about the longitudinal axis. When the plasma has finite thickness, it has a stable configuration position in which its cross section must be circular. (D.C.W.)

42054 (UCRL-10206) PLASMA GUN ASPECTS OF AN E X B SYSTEM. Klaus Halbach and William R. Baker (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 11, 1963. Contract W-7405-eng-48. 6p.

The advantages, design, and operation of a plasma gun based on the Homopolar V geometry are described; and the parameters that will be maintained in its operation are discussed. (D.C.W.)

42055 (FTD-TT-62-1238) LIMITS OF STABLE EXISTENCE OF POSITIVE GAS DISCHARGE COLUMN. I. A. Poletaev. Translated from Zh. Tekhn. Fiz., 21: 1021-8 (1951). 13p. (AD-292664)

The conditions under which a positive column can exist stably, as well as the causes of the extinction of the column when the conditions are disrupted, are analyzed. (auth)

42056 ELECTRICAL RESISTANCE AND SHEATH POTENTIAL ASSOCIATED WITH A COLD ELECTRODE. Donald L. Turcotte and James Gillespie (Cornell Univ., Ithaca, N. Y.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 2293-9(Oct. 1963).

The boundary-layer resistance and the difference in sheath potentials between a pair of electrodes were measured in a shock tube. Using a small, square electrode and a strip electrode flush with the wall of the shock tube, the electric current could be drawn across the shock tube was measured as a function of the shock wave position for several applied voltages and load resistances. All measurements were made in air at a shock speed of 4.35 mm/μsec and an initial pressure of 1 mm Hg. In the range of applied voltages considered, the boundary-layer resistance was not a function of the current level. The change in the sheath potential was of the order of several volts. A continuum theory is developed to predict the boundary-layer resistance for small current levels and the sheath potential. The sheath solution is separated from the convective compressible boundary-layer problem where ambipolar diffusion dominates. In the sheath, the transport equations for ions and electrons in an electric field are solved numerically. Resulting integrals for the dimensionless boundary-layer resistance and sheath potential are evaluated, both in the sheath and in the compressible boundary layer, to obtain results that can be compared with experiment. Values of the resistance obtained, assuming the ionization reaction to be frozen, are not in agreement with experiment. Reasonable agreement between theory and experiment is obtained for the magnitude of the sheath potential. (auth)

42057 ON THE CONFINEMENT OF PLASMA IN MAGNETIC BOTTLES. F. Gascon. Anales Real Soc. Esp. Fis. Quim. (Madrid), Ser. A, 59: 35-8(Mar.-Apr. 1963). (In Spanish)

Considerations are given for the motion of plasma particles between magnetic mirrors, and evaluations are made of the percentage of particles that are confined, provided that the variation of the magnetic moment in the longitudinal oscillation is known. (B.O.G.)

42058 INSTABILITY OF GAS DISCHARGES IN A MAGNETIC FIELD. F. C. Hoh. Arkiv Fysik, 24: 285-302 (1963). (In English)

It is shown that a high-pressure Penning-type discharge is unstable against a macroscopic, m = 1 perturbation. The instability is analyzed with a dimensional dispersion relation. The applicability of the dimensional method is shown for a special case. A steady-state model of some experimental Penning-type discharges is given. On the basis of this simple model, the critical magnetic field for the onset of instability as predicted by the theory agrees well with that observed. The instability of the positive column is reconsidered with the dimensional method. It is shown that the instabilities of the Penning-type and of the positive column discharges are closely related, being special cases of the more general three-fluid type of instability. (auth)

42059 PLASMA DYNAMICS AND THERMONUCLEAR REACTIONS. H. S. Green (Univ. of Adelaide). At. Energy Australia, 6: No. 4, 2-6(Oct. 1963).

The principles of plasma dynamics and their relation to the production of a self-sustaining thermonuclear process are discussed. The synthesis of helium from the heavy isotopes of hydrogen is discussed. The containment of the plasma and compression of the plasma is presented in terms of pinching and shock waves. (R.E.U.)

42060 THE DESIGN AND CHARACTERISTICS OF HIGHLY IONIZED HYDROGENOUS LABORATORY PLASMA SOURCES. M. H. Brennan, J. A. Lehane, D. D. Millar, and C. N. Watson-Munro (Univ. of Sydney). Australian J. Phys., 16: 340-52(Sept. 1963).

The design and construction of two highly ionized hydrogenous plasma sources are described. Details are also given of the measurements that were made to investigate the formation, density distribution, and decay of plasmas. (auth)

42061 ELECTRON ENERGY LOSS AT COLLISION IN CURRENT-MAINTAINED PLASMAS. J. M. Somerville (Univ. of New England, Armidale, New South Wales). Australian J. Phys., 16: 430-3(Sept. 1963).

It is shown how the existence of two distinct types of current-maintained plasmas may be inferred from inspection of a plot of measurements of electron density against current density for a variety of discharges. (R.E.U.)

42062 MICROWAVE INTERFEROMETRY FOR PLASMA STUDIES. L. C. Robinson and L. E. Sharp (Univ. of Sydney). Australian J. Phys., 16: 439-46(Sept. 1963).

A microwave interferometer is described. The advantage of using microwave probes is the minimal perturbation of the plasma. To a wave of frequency greater than the electron plasma frequency the plasma behaves like a dielectric, causing a change in the path which yields the average electron density. The attenuation of the probing wave can give the collision frequency and the plasma temperature. (R.E.U.)

42063 DELAYED IMPLOSION OF THE Z-PINCH IN NITROGEN. F. L. Curzon, R. T. Hodgson, and R. J. Churchill (Univ. of British Columbia, Vancouver). Can. J. Phys., 41: 1547-53(Oct. 1963).

The first photographic evidence of the delayed implosion of the Z-pinch in nitrogen at pressures in excess of 375 μ Hg is presented. Two implosions are observed before the discharge column is compressed to its minimum diameter. The time interval between the two implosions is found to increase linearly with pressure. The radius of the discharge column is measured as a function of time with a framing camera and is also calculated from the electrical characteristics of the discharge. By comparing the computed and measured values of the radius of the discharge column at given pressures, it was shown that the second implosion does not arise from a transfer of the discharge current into material near the walls of the discharge vessel, in contrast to results commonly observed in very energetic discharges. (auth)

42064 ACCELERATION AND DECLERATION OF PLASMAS IN ELECTROMAGNETIC SHOCK-TUBES. G. D. Cormack (Univ. of British Columbia, Vancouver). Can. J. Phys., 41: 1591-1603(Oct. 1963).

The applicability of snowplow theory for the description of the motion of plasmas in electromagnetic shock tubes is studied. The effects of various means of mass pickup and of various wave forms of driving current are included in the analysis. A comparison of the theoretical predictions with experimental results reveals the importance of materials eroded from the components of the driver. Snowplow theory is also found to predict the observed motion of the declerating plasma fairly accurately when the initial pressure in the shock tube is low and the mass of the driver gases large. The proposed model for the decelerating plasma is suggestive of one reason, a large mass of gases present, why various workers have obtained different values for β in the often-quoted relation $x \propto t^{\beta}$. (auth)

42065 MUTUAL NONLINEAR INTERACTION OF A NUMBER OF ELECTROMAGNETIC WAVES IN A PLASMA. Mahendra Singh Sodha and Carl J. Palumbo (Republic Aviation Corp., Farmingdale, N. Y.). Can. J. Phys., 41: 1702-11(Oct. 1963).

An expression is obtained for current density in a slightly ionized uniform plasma in the presence of a number of electric fields of different frequencies by solving the appropriate Boltzmann's equation. This expression along with the wave equation was used to investigate the nonlinear mutual interaction of a number of electromagnetic waves, propagating in a plasma. Limitations of the present analysis are indicated and the physical significance of the results is discussed. The technique was applied to investigate the mutual interaction of amplitude-modulated waves, and the results express a generalization of Luxembourg effect to a number of strong modulated waves. (auth)

42066 THE EXPRESSION, VALIDITY, AND APPLICATION OF A STABILITY CRITERION. Jean Andreoletti (CEN, Saclay, France). Compt. Rend., 257: 1033-6(July 29, 1963). (In French)

A necessary and sufficient stability criterion has been established (Compt. Rend., 256: 1469(1963)) for a low-pressure hot plasma without magnetic surfaces. Another expression of this criterion and three other means of obtaining it are given. It is shown that it is not modified by mirror losses and by the effect of low resistivity. The interest of "magnetic wells" is discussed. (tr-auth)

42067 INSTABILITIES OF THE OSCILLATIONS OF A COMPOSITE PLASMA. Nicole Bel (Institut d'Astrophysique, Paris). Compt. Rend., 257: 1222-4(Aug. 5, 1963). (In French)

A cylindrical strand of plasma is considered that is surrounded by an infinite plasma having properties similar to those of the cylinder. The cylindrical strand is supported by a cylindrical, longitudinal skin current, which gives rise to a circular component of the magnetic field in the exterior plasma. In the region of applicability of magnetohydrodynamics, the effects of infinitesimal perturbations of the equilibrium state of this type of plasma are studied. The boundary conditions at infinity and at the cylinder surface permit a dispersion relation to be found, from which stability criteria can be derived. (T.F.H.)

42068 METHODS FOR SYSTEMATIC STUDY OF MAGNETIC WELLS. Jean Andreoletti (Centre d'Études Nucléaires, Saclay, France). Compt. Rend., 257: 1235-7 (Aug. 5, 1963). (In French)

The study of the stability of a low-pressure plasma in a strong magnetic field shows "magnetic wells," i.e., fields in which exist a finite volume in which the energy density $B^2/2\mu_0$ presents a minimum. Two methods are established for systematically studying these wells. (tr-auth)

42069 LANDAU DAMPING OF LONGITUDINAL WAVES OBTAINED FROM THE MACROSCOPIC EQUATIONS FOR A COLLISIONLESS PLASMA. Daniel Quemada (Laboratoire des Hautes Énergies, Orsay, France). Compt. Rend., 257: 1455-7(Aug. 12, 1963). (In French)

The determination of the perturbation moments from the perturbation of the distribution function, which is determined from the linearized Vlasov equation, leads to relations between the moments. These relations, used as cutoff conditions for the system of macroscopic equations, lead to differential equations, which when integrated yield a dispersion equation that contains Landau damping. (tr-auth)

42070 STATIONARY STATE OF A PLASMA AT LOW PRESSURE, IN THE PRESENCE OF AN AMBIPOLAR ELECTRIC FIELD. Jean Andréoletti (Centre d'Études Nucléaires, Saclay, France). Compt. Rend., 257: 1458-60 (Aug. 12, 1963). (In French)

By considering the probability distributions of the magnetic field lines, a condition is obtained under which a low-pressure plasma in an ambipolar electric field has a stationary state. It is shown that three classes of states satisfy this condition. (tr-auth)

42071 INSTABILITY OF A GASEOUS DISCHARGE IN A MAGNETIC FIELD WITHOUT A LONGITUDINAL CUR-

RENT. A. V. Timofeev. Dokl. Akad. Nauk SSSR, 152: 84-7(Sept. 1, 1963). (In Russian)

A dissipative drift instability of a plasma transverse to the magnetic field was observed experimentally, and is proved mathematically. The kinetic motion of the electrons was described by a drift approximation. The equation for the ion motion was written, and the ion inertia was taken into account. With a small perturbation of the electron distribution function f_1 and of the potential of the electric field q_1, an expression was obtained for the perturbation in electron density $n_{1e} = \int f\, dv_z$, and also for the perturbation in ion density. A dispersion equation for the frequency was obtained by equating the ion and electron density perturbations on the assumption of quasineutrality. The long-wavelength, ion-acoustical vibrations with $\sqrt{T/m}\ \tau_e > k_x^{-1}$ and frequency $\tau_e^{-1} > \omega > \Omega_i$ were described by a hydrodynamical approximation. It was assumed that $\mathrm{Im}\omega = 0$ at the limit of instability. An equation was also written for the short-wavelength vibrations, but the hydrodynamic approximation was no longer valid. An instability could be found only at $|\omega| < k_y v^+$. Oscillations with $k_z^2/k_y^2 > b_i/b_e$ at the largest possible value of k_y occurred most readily. Here it was assumed that $k_y > k_x > \chi = n_0^{-1}\, dn_0/dx$. The region of instability consisted of three overlapping zones: (1) a drift region with $\omega < \Omega_i$ ($\Omega_e = eH/mc$ is the cyclotron frequency). At large value of H when $\Omega_i < \tau_e^{-1}$ (τ_e is the time between the collision of an electron and a neutral atom), the drift instability becomes a collision-free instability; (2) an ion-acoustical region with $\omega > Q_i$, where the oscillation is due to a diffusion mechanism at $\omega < \tau_e^{-1}$, and to resonance electrons with $v_z = \omega/k_z$ at $\omega > \tau_e^{-1}$; and (3) a small region with unstable ion-acoustical oscillations due to electron collisions. (TTT)

42072 MOTION OF CHARGED PARTICLES IN A STRONG MAGNETIC FIELD WITH A STRONG TRANSVERSE ELECTRIC FIELD PRESENT. V. S. Kudryavtsev. Dokl. Akad. Nauk SSSR, 152: 313-16(Sept. 11, 1963). (In Russian)

The equations of the motion of charged particles in electric and magnetic fields in the non-relativistic case are: $dr/dt = v$; $dv/dt = eD/m + evB/mc$. The sum of the terms on the right side of the second equation is equal to the ratio of the electric drift velocity $cE_\perp/B$ to the particle velocity v, and is of the order of $\epsilon = mc^2v/eBLc$. In this case the displacement of the Larmor circumference per unit revolution is small as compared to the Larmor radius. The velocity of the electric drift $cE_\perp/B$ is not too small, and can be the same order of magnitude as the particle velocity v. The component of the electric field normal to the mangetic field $E_\perp$ increases by $1/\epsilon$, so that $E_\perp/B \sim v/c$, while the corresponding parallel component $E_\parallel/B \sim \epsilon v/c \sim mc^2/eBL(v/c)^2$. Therefore, $dv/dt = E_\parallel + E_\perp/\epsilon + [vB]/\epsilon$. The average equations of the drift are given by the expressions involving Poisson brackets and a Hamiltonian function. The equation of the motion is obtained by changing the variables so that cylindrical co-ordinates do not appear in the Poisson brackets. (TTT)

42073 CONCERNING UNOPLASMATRON ION SOURCE WITH SMALL DIMENSIONS. Manfred von Ardenne and Ullrich Heisig (Forschungsinstitut Manfred von Ardenne, Dresden). Exptl. Tech. Physik, 11: 26-31(1963). (In German)

Discharge mechanisms, performance, and manner of operation of a unoplasmatron ion source are described. From given measurements resulted the optimal data on operation and characterictics of the source built with small dimensions for the emission of argon ions. For a 1-ma argon ion flux the ionization efficiency amounted to 0.15 and the ion yield to about 10^{-2} ma W^{-1}. (tr-auth)

42074 A NEW METHOD FOR INCREASING THE OUTPUT OF A PLASMA SOURCE FOR NEGATIVE IONS. H. Drost, U. Timm, H. Behlke, and H. Pupke (Inst. of Biophysics, German Academy of Sciences, Berlin). Exptl. Tech. Physik, 11: 246-53(1963). (In German)

A method is described with which the yield of a plasma source for negative ions can be increased from 10^{-10} to 2.1×10^{-6} amp. It consists in the fact that a retiform auxiliary electrode provided with a central opening was installed in the anode region of the source discharge, through which the discharge plasma can concentrate on the absorbing anode. Also necessary for preservation the high ion current appeared to be the existence of an anode-lateral plasma charge. The role of an auxiliary electrode consists of guaranteeing the formation or fixation of such a plasma charge before the anode opening. This charge effect causes an additional intensity increase for each mechanical or electrostatic discharge. (tr-auth)

42075 INVESTIGATION OF A PLASMA SOURCE FOR NEGATIVE IONS. I. THE ION SOURCE. H. Drost, U. Timm, and H. Pupke (Inst. of Biophysics, German Academy of Science, Berlin). Exptl. Tech. Physik, 11: 254-65(1963). (In German)

After a complete treatment of the construction principles as well as the building and operation of the source apparatus, an investigation was made with regard to the optimum conditions for the production of maximum ion yields. The investigation was concerned with the dependence of ion yield on the discharge parameters, the amount of acceleration voltage, the mechanical and electrostatic charge distribution by the auxiliary electrode, and distance of auxiliary electrode from the anode. A surface analysis of the extracted ions showed 4 maxima, which were assigned to the H^-, O^-, O_2^-, and NO_2^- or NO_3^- ions. (tr-auth)

42076 INVESTIGATION OF A PLASMA SOURCE FOR NEGATIVE IONS. II. THE AUXILIARY ELECTRODE. H. Drost, G. Lindemann, U. Timm, and H. Pupke (Inst. of Biophysics, German Academy of Sciences, Berlin). Exptl. Tech. Physik, 11: 266-74(1963).. (In German)

The investigation of the discovery of the optimum operation conditions of the plasma source was continued on the anodic auxiliary electrode. Variation of the electrode form (cylindrical, disk-shaped, grating-shaped, and double electrodes), the metallic residual surface for perforated auxiliary electrodes, and the kind of metal proved that a grating-shaped Al electrode is especially favorable for discharge of maximum ion intensity. In experiments with different forms of electrode middle fillers, a conical filler in an Al grating led to a further increase in ion yield to 2.1 μa. The cause of the high source power was seen in the formation of a bubble-shaped discharge before the absorbing anode as well as in a plasma condensation. (tr-auth)

42077 DIPOLE RESONANCES OF A PLASMA IN A MAGNETIC FIELD. F. W. Crawford, G. S. Kino, and A. B. Cannara (Stanford Univ., Calif.). J. Appl. Phys., 34: 3168-75(Nov. 1963).

It is known that cylindrical plasma columns subjected to a transverse electric field exhibit dipole resonance effects. Very little attention was given to the modification of this phenomenon by a magnetic field. A theory is given for the splitting of the resonance that occurs under these conditions, and experiments carried out using mercury-vapor discharges at a pressure of about 1 μ Hg are described to verify the theoretical prediction. Good agreement was ob-

tained for magnetic fields giving an electron cyclotron frequency up to about half the geometric mean-resonant frequency, and it is suggested that the effect provides a useful diagnostic technique for the measurement of mean electron density and magnetic field in discharge columns. (auth)

42078 HYDRODYNAMIC THEORY OF PLASMA DENSITY FLUCTUATIONS. Marshall H. Cohen (Cornell Univ., Ithaca, N. Y.). J. Geophys. Res., 68: 5675-9(Oct. 15, 1963).

The spectrum of electron density fluctuations is computed using a collisionless two-fluid plasma model with isotropic pressure. The major disagreements with kinetic theory are that the fluid theory gives sharp lines only, with no Landau broadening, and the gyro-resonant structure of the kinetic theory is missing in the fluid theory. (auth)

42079 THE ENERGY SPECTRA OF THE NEUTRONS FROM "ZETA." R. A. Coombe (Univ. of Birmingham, Eng.) and B. A. Ward. J. Nucl. Energy, Pt. C, 5: 273-83 (Sept.-Oct. 1963).

The energy of neutrons emitted tangential and perpendicular to the discharge axis of ZETA was measured using a hydrogen-filled diffusion cloud chamber. Several different discharge conditions were studied. It is concluded that the neutron emission is due to a small number of high-energy deuterons. In addition, analysis of the shape of the neutron spectra suggests the possibility that the deuterons have a velocity which is predominantly perpendicular to the gas current axis and that they travel in a helix with energies up to 350 kev. (auth)

42080 ON THE HIGH-FREQUENCY RESPONSE OF A ROGOWSKI COIL. J. Cooper (Imperial Coll. of Science and Tech., London). J. Nucl. Energy, Pt. C, 5: 285-9 (Sept.-Oct. 1963).

A Rogowski coil with a capacitive shield is treated as a distributed circuit, so that the toroidally wound coil acts as a delay line. It is shown that, in general, the high-frequency response is limited by the transit time around this delay line, and for times greater than this transit time the individual circuit elements act as lumped impedances. However, if the flow of the current to be measured is such that it is symmetrical with respect to the toroidal coil (so that the voltage induced per unit length along the coil, when the current changes, is constant), the transient response becomes less than the transit time for a termination whose impedance is small compared with that of the toroidal coil. The best results may be obtained with an inductive termination whose impedance has the same phase angle as the impedance of the toroidal coil; and for this termination the output is proportional to the rate of change of current. (auth)

42081 INTERACTION BETWEEN PLASMA OSCILLATION AND RADIATION FIELD I; RADIATION DAMPING OF PLASMA OSCILLATION. Kenya Matsuura (Electrotechnical Lab., Tokyo). J. Phys. Soc. Japan, 18: 1319-25 (Sept. 1963).

The interaction mechanism between plasma oscillation and radiation field in high temperature plasmas is discussed with quantum mechanical treatment in the absence of external magnetic field. The radiation damping of plasma oscillation is evaluated and compared with the Landau damping, mode-coupling damping, and collision damping. The radiation damping is much larger than the Landau damping in the range of wave vector of plasma oscillation $k < k_D/7$ and is smaller than the mode-coupling damping by the order $(v_T/c)^3$ for all range of k, where k_D is the Debye cut-off wave vector, v_T is the mean thermal speed of electrons and c is the light velocity. (auth)

42082 GRAVITATIONAL INSTABILITY IN A PLASMA IN A MAGNETIC FIELD. I. IDEAL MAGNETOHYDRODYNAMICS. Ichiro Kawakami and Masatomo Sato (Nihon Univ., Tokyo). J. Phys. Soc. Japan, 18: 1334-9(Sept. 1963).

The instability of a plasma supported under gravity by a magnetic field is reconsidered using the magnetohydrodynamic equations of a perfectly conducting fluid. It is shown that the wave number (k) of physically important perturbations is limited to $ka \simeq 1$ by a finite thickness (a) of the plasma-vacuum boundary surface, and the instability growth rate is given by $\propto (g/a)^{1/2}$. There are some experimental supports for this result in the theta-pinch data. It is also pointed out how the interchange picture of the instability for a low β case will be generalized in a high β case, where β = (plasma pressure)/(magnetic pressure). (auth)

42083 MICROWAVE FREE SPACE METHOD WITH LENS ANTENNAS FOR PLASMA DIAGNOSTICS. Shinji Shiobara, Syoichi Miyoshi, and Yuichi Sakamoto (Inst. of Physical and Chemical Research, Tokyo). J. Phys. Soc. Japan, 18: 1341(Sept. 1963).

Two series of microwave measurements were carried out at 34 Bc/sec to see to what extent the method is accurate in measuring the electron density in a gaseous plasma. In the first experiment no lenses were used in the test path of the interferometer bridge, but in the second, teflon lenses were inserted between the plasma and the horn antennas to diminish the intensity of diffracted microwave signals. (R.E.U.)

42084 EFFECT OF CAPACITOR ARRANGEMENT ON THE SYMMETRY OF LINEAR PINCH DISCHARGES. Donald P. Duclos, Leonard Aronowitz, and Frederic P. Fessenden (Republic Aviation Corp., Farmingdale, N. Y.). Nature, 200: 59(Oct. 5, 1963).

The effect of capacitor arrangement on the symmetry of a linear pinch discharge during the phase of the discharge when the current distribution was moving toward the axis was investigated using a pinch plasma accelerator. The symmetry of the discharge was determined by comparing the magnitude and time of arrival of signals from 4 magnetic probes. Results indicated that when the capacitors are not arranged symmetrically, the current may not be distributed uniformly enough throughout the transmission line plates for a symmetric discharge to occur. (M.C.G.)

42085 PROCEEDINGS OF THE CONFERENCE ON PLASMA PHYSICS AND CONTROLLED NUCLEAR RESEARCH, 4-9 SEPTEMBER 1961, SALZBURG, AUSTRIA. Nucl. Fusion, Suppl. 2, Pt. 3: 869-1327(1962). Vienna, International Atomic Energy Agency, 1963. 466p. $10.00. Sch 210; 60s. stg; NF 40; DM 35.

Papers concerning pinch discharge phenomena such as runaway electrons, stability, ion energies, electric and magnetic field fluctuations, plasma losses, Hall effect, plasma diffusion, particle motion on magnetic flux surfaces, double-stream instability, ion cyclotron waves, damping of electron oscillations, magneto-acoustic resonance, plasma energy absorption from electromagnetic fields, Joule heating, impurity effects on ionization and heating, atomic particle emission, noise radiation, and magnetic confinement were presented. Other topics included electron beam-plasma interactions, effect of electric and magnetic fields on plasma, and spectroscopic investigations of plasma discharges. Separate abstracts are prepared for 27 of the 29 papers presented. Abstracts of two papers previously appeared in NSA (16: 4902 and 28301). (C.E.S.)

42086 COMPARISON BETWEEN THEORY AND EXPERIMENT FOR THE STABILITY OF THE TOROIDAL PINCH DISCHARGE. A. A. Ware (Associated Electrical Industries, Aldermaston, Berks, Eng.). Nucl. Fusion, Suppl. 2, Pt. 3: 869-76(1962).

A summary is given of the experimental observations that are relevant to the stability of the toroidal pinch discharge. This includes recent measurements on the wave velocity of fluctuations in the Sceptre experiments and the recent observation of steps on the magnetic field oscillograms with the torus. These results are first compared with the stability predictions based on the magnetohydrodynamic (MHD) approximations (the energy principle). The experimental results indicate that of the MHD modes, only the interchange mode can be occurring with large amplitude in practice. Secondly, the stability predictions based on more accurate plasma equations are compared with experiment. These include the entropy waves discovered by Tserkovnikov and Kadomtsev and the prediction that the MHD modes move as waves. Lastly, it is shown that if instabilities keep $|\nabla p| \ll | \sigma_{||} E_{||} B|$, the rapid penetration of B_0 into the pinch discharge and the enhancement of B_z can be explained. (auth)

42087 THE INFLUENCE OF THE HALL EFFECT ON A SIMPLE HYDROMAGNETIC STABILITY PROBLEM. R. J. Tayler (United Kingdom Atomic Authority, Culham, Berks, Eng.). Nucl. Fusion, Suppl. 2, Pt. 3: 877-81(1962).

An exact solution is given for one very simple problem in which the Hall current is included. This is the stability of an incompressible conducting fluid containing a uniform axial magnetic field and a uniform axial current density and filling a conducting tube. For this problem it is shown that overstability does occur but that the system including the Hall effect is never overstable when the system without the Hall effect is stable. In addition, when overstability occurs, the real part of the growth rate is smaller than it is when the Hall effect is absent; thus the instability waves grow more slowly than the original instabilities. If the ion gyration frequency is much less than the characteristic hydromagnetic frequency the band of unstable wavenumbers becomes very small. (auth)

42088 SPECTROSCOPIC INVESTIGATION OF PLASMA IN THE WAVELENGTH RANGE 0.1-2.0 MM. G. N. Harding (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and V. Roberts. Nucl. Fusion, Suppl. 2, Pt. 3: 883-7(1962).

The radiation emitted by Zeta in the wavelength range 0.1-2.0 mm was measured with a vacuum grating spectrograph. The detector was either a carbon bolometer or an indium antimonide photo-conductor, giving time-integrated and time-resolved measurements, respectively. Continuous spectra were obtained that can be explained on the basis of free-free emission and absorption. At short wavelengths the plasma is optically thin, and at long wavelengths a blackbody spectrum is obtained. Thus both electron temperature and density can be found. Measured values of these parameters obtained under varying conditions of pressure and magnetic field are presented and their significance discussed. (auth)

42089 SPECTROSCOPIC STUDIES OF ION ENERGIES IN ZETA. B. B. Jones and R. Wilson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Fusion, Suppl. 2, Pt. 3: 889-93(1962).

The energies of trace ions in a Zeta deuterium plasma are determined from measures of the Doppler widths of spectra lines emitted in the vacuum ultraviolet. The instrument used is a normal-incidence, 3-meter, vacuum spectrograph giving a reciprocal linear dispersion of 2.8 Å/mm. The inert gases neon, argon, krypton, and xenon are added to act as trace elements and give a selection of spectral lines that embrace a considerable range in ion charge and mass. Several new lines due to the more highly ionized species were identified for this purpose. Photographic-plate calibration is achieved by an aperture restriction system located at the Sirks focus. This gives a step distribution in the focal plane with an intensity ratio of 2 : 1. A simple analysis of the motion of ions in time-varying electric fields in a magnetically constrained plasma shows that their energies depend on their charge and mass and the characteristic frequency of the perturbing field. This is used as a guide in interpreting the observations. It is shown that the ion energies vary with time of appearance, and conclusions concerning the heating mechanism are based on observations of different ionic species made at the same time. The ion energies E_i, can be represented by a constant energy plus an energy corresponding to a common velocity system, the directed motion being perpendicular to the magnetic field. The heating mechanism is interpreted as a low-frequency perturbation, perpendicular to the magnetic field lines showing a marked degree of relaxation towards thermalization. For one specific condition, $E_i = 102 + 2.3\ M_i/M_D$ (ev). This is used to deduce the deuteron energies and a relaxation time of 13 μsec is calculated for the directed mode. This agrees well with the ion-ion relaxation time. Calculation of the equivalent electric field driving the directed mode gives a value of the same order as that observed with electrostatic probes. The ion energies and electrostatic fluctuations are consistent with each other. (auth)

42090 ELECTRIC AND MAGNETIC FIELD FLUCTUATIONS IN HIGH-CURRENT TOROIDAL DISCHARGES. M. G. Rusbridge, D. J. Lees, and P. A. H. Saunders (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Fusion, Suppl. 2, Pt. 3: 895-901(1962).

Electric-field probes and magnetic search coils were used to observe low-frequency fluctuations in discharges in Zeta and a similar torus of smaller bore. The amplitude of the fluctuations was measured as a function of discharge conditions and the results are summarized briefly. A simple ideal hydromagnetic model is introduced that fits the observed magnetic field fluctuations closely; this shows that the principal perturbation has a long wavelength and azimuthal symmetry number m = 1. The rms plasma displacement is less than 10% of the discharge tube radius under normal conditions. The origin of the observed electric-field fluctuations is discussed, and an equation is derived that in principle relates the electric and magnetic-field fluctuations. The observed electric-field amplitudes are shown to be consistent with this result, but the coefficient of correlation between the electric and magnetic-field fluctuations is small. A characteristic frequency for the fluctuations is estimated by counting the number of maxima per unit time. This frequency varies approximately inversely as the square root of gas pressure and directly with the magnetic field at the center of the discharge; this is consistent with the hydromagnetic model described above. The form of the dispersion relation for hydromagnetic waves in a cylindrical discharge is discussed in the light of these results, and theoretical results on the stability of a particular model of the discharge are given. The origin and maintenance of the fluctuations and their significance for the diffusion of plasma across containing magnetic fields are discussed. (auth)

42091 PLASMA LOSS IN ZETA. W. M. Burton, E. P. Butt, H. C. Cole, A. Gibson, D. W. Mason, R. S. Pease, K. Whiteman, and R. Wilson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Fusion, Suppl. 2, Pt. 3: 903-19(1962).

Observations are presented on the Zeta discharge in deuterium at initial pressures of 0.25-20 mtorr and in other gases, at currents of 100-900 kamp. The observations are interpreted in terms of energy loss and of plasma loss and injection. The phenomena observed depend on a number of parameters, of which the loss process appears to be governed mainly by the energy input per unit mass of plasma ϵ. At values of $\epsilon > 1$ kev per proton mass the energy loss is due to a plasma loss-and-injection process. Plasma containment times of about 100 μsec were measured by spectroscopic, energy-balance and electric-field-fluctuation methods. The plasma mass motions required agree with those measured spectroscopically. There is a net pump-out of plasma during the discharge and measurements show that when the line density falls to about 6×10^{16} cm^{-1}, there is a catastrophic runaway process in which the energy is carried to the walls by runaway electrons. At values of $\epsilon < 1$ kev, the energy is mainly radiated, and plasma containment times of about 10^{-3} sec with β values of 5% can be inferred; under those conditions, however, the temperatures are $< \sim 10$ ev. The loss of plasma is associated with an excess resistance, whose presence is established by comparison of observed resistance with resistance calculated from electron-temperature measurements. This excess resistance corresponds to the energy used in driving the plasma to the walls and heating the ions to the high temperature. The diffusion loss process is therefore likely to be driven by the electromagnetic forces rather than by Joule heating of the plasma. The nature of the mechanism is not clear, but evidence suggests a possible connection with discontinuities in the current waveforms, which may be associated with integral numbers of helices formed by the magnetic field configuration in the torus. (auth)

42092 INVESTIGATION OF A CURRENT OF ATOMIC PARTICLES EMITTED BY A PLASMA. V. V. Afrosimov, I. P. Gladkovskii, I. F. Kalinkevich, M. P. Petrov, and N. V. Fedorenko (Ioffe Inst. of Physics and Tech., Leningrad). Nucl. Fusion, Suppl. 2, Pt. 3: 921-7(1962). (In Russian)

A new method of plasma diagnostics, based on investigations of the flux of neutral atomic particles emitted by a plasma, makes it possible to determine the magnitude of the flux of neutral particles having energies above 100 ev, investigate the energy distribution of the particles and their flux distribution over time, and analyze them according to mass. In measuring the flux parameters, the individual particles are registered after their conversion to ions by collision stripping in a gas and acceleration with a voltage of 10 to 20 kv. The method was used on the Alpha assembly to study a flux of neutral particles emitted by a plasma, with energies ranging from 100 ev to 10 kev. It was found that the flux consists for the most part of atomic hydrogen. The energy distribution of the atoms does not have a maximum in the energy range above 100 ev; thus it is not a Maxwellian distribution. The data show that the presence of this flux in the Alpha assembly is one of the main causes of energy losses from a plasma. A number of thoughts regarding the mechanism of neutralization of ions in a plasma are put forward on the basis of experimental data; the relation between the energy distribution of the atoms emitted by a plasma and that of ions in the plasma is also examined. (auth)

42093 SPECTRAL INVESTIGATIONS IN THE "ALPHA" DEVICE. A. B. Berezin, A. N. Zaidel, G. M. Malyshev, G. T. Razdobarin, and V. V. Skadan (Academy of Sciences, Moscow). Nucl. Fusion, Suppl. 2, Pt. 3: 929-34(1962). (In Russian)

The line intensities of oxygen ions of different multiplicities (O III, O IV, O V), as well as the line intensities of different ions of the same multiplicity (N IV, O IV), were simultaneously recorded on the Alpha device, by means of several photomultipliers. The duration of the luminescence of all lines increases with an increase in the voltage of the condenser bank. At small voltages (10 kv) the luminescence of the lines O III, O IV, N IV, and O V has a single maximum in mid-pulse, while at larger voltages (15 kv) all lines have two maxima, at the beginning and at the end of the pulse. The intensity stage of lines belonging to ions of different multiplicity shows that the appearance of two maxima cannot be explained merely by an increase in the degree of ionization near the maximum current in the middle part of the discharge pulse. Investigation of the frequencies of the intensity oscillations showed that up to several tens of kilohertz, changes in the intensities of all lines are approximately the same. Oscillations of higher frequencies are evidently not intercorrelated. It should be remarked that the frequencies of oscillation of the spectral line intensity are larger than the frequencies of oscillation of the discharge current. The luminescence of line N IV emitted by different regions of the discharge was also studied. It was established that the intensity shape of this line emitted by two volumes of plasma, approximately 1 m apart, is identical in the low-frequency region (up to 10 kHz). In the higher frequency region the character of the luminescence from both volumes is independent. With a distance of several centimeters between luminescent volumes, there is complete correlation of luminescence for frequencies up to 100 kHz and a different detailed shape for higher frequencies. In order to reveal collective motions in the plasma, the shapes of the long-wave and short-wave halves of the line N IV, which was divided with the aid of an optical device, were simultaneously recorded. Where Doppler shifts of the lines are small and the collective motion contribution to the broadening of the line is correspondingly small, quantitative treatment of the experimental material proves fairly simple. In this case the ratio of line-shift $\Delta\lambda$ to its half-width α is approximately expressed by the relation $\Delta\lambda/\alpha = \beta/2$, where β is the ratio of the difference of recorded luminescence currents to their sum. The results of treating the experimental material show that the relative shift of spectral lines, corresponding to collective motions under the prevalent operating conditions of the Alpha device, do not exceed 15%, and the total contribution of collective motions to broadening of the line N IV during pulse time is considerably less than this upper limit. From examination of the material obtained, the conclusion may be drawn that the velocities of collective motions do not exceed 10^6 cm/sec; i.e., they are of the same order as the previously measured velocities of the directed motion along the electric field. (auth)

42094 INVESTIGATION OF NOISE RADIATION BY A HOT PLASMA IN THE CENTIMETER AND MILLIMETER WAVELENGTH RANGE. M. M. Larionov (Academy of Sciences, Moscow). Nucl. Fusion, Suppl. 2, Pt. 3: 935-9 (1962). (In Russian)

The absorption coefficient of an actual hot plasma (electron concentration, 10^{12} to 10^{14} cm^{-3}, electron temperature exceeds 10^5°K) was calculated for waves from 10 cm to 2

mm. For a plasma in free space the absorption coefficient is almost always much less than unity. Thus the absorption coefficient can only be very roughly evaluated. However, there are conditions under which the absorption coefficient approaches unity within a wide frequency range. This considerably facilitates measurement of the electron temperature by means of noise radiation. If the plasma is surrounded by a closed metal sheath and if an ultra-high-frequency signal is radiated by an antenna introduced into the sheath, then the signal is subjected to multiple reflections within the sheath. In this manner the signal repeatedly interacts with the plasma passing through it or being reflected from it. Such a signal will finally be absorbed in the plasma because the absorption coefficient is much smaller for a single reflection from the metal than for a single interaction with the plasma. If the radiation of the plasma enclosed in the sheath is considered, then it will be in thermal equilibrium with the plasma electrons because the absorption in the walls is small. By measuring the density of such a radiation by an antenna that is introduced into the sheath, it is possible to determine the electron temperature of the plasma. An analysis is made of the noise radiation of a strong toroidal discharge occurring in the metal chamber of the Alpha device. Noise radiation was observed. It was also observed that the signals on waves of 8.2, 16, and 32 mm pass through the plasma and are reflected from the plasma. On the basis of observations of transitions and reflections of the signals, it was established that the chamber containing the plasma has (under some conditions) an absorption coefficient approaching unity. The noise temperatures of the plasma were measured under various operating conditions of the device. Oscillograms of the noise temperature during the discharge time were obtained. A noise temperature from 1.5×10^5 to 1.2×10^6°K was recorded by measurement on waves of 8.2 and 16 mm. In measurements on a 32-mm wave in some cases a very strong radiation from the plasma was observed. (auth)

42095 EXPERIMENTS IN JOULE HEATING OF PLASMA IN A STRONG MAGNETIC FIELD. E. P. Gorbunov, G. G. Dolgov-Savelev, K. B. Kartashev, V. S. Mukhovatov, V. S. Strelkov, M. N. Shepelev, and N. A. Yavlinskii (Academy of Sciences, Moscow). Nucl. Fusion, Suppl. 2, Pt. 3: 941-8(1962). (In Russian)

A pulsed electrodeless deuterium discharge with lifetime of 5–7 μsec in a strong longitudinal magnetic field was studied. It is shown that in the first stage of the discharge anomalously rapid losses of charged particles from the plasma take place. The average containment time of the electrons was usually ~600 μsec. The electrical characteristics of the discharge are observed to oscillate. The amplitude of these oscillations increases noticeably when the electron-density curve passes through a maximum. The possible mechanisms for the appearance of such oscillations as well as the mechanisms for charged particle losses are discussed. The ion temperature determined by the Doppler broadening of the hydrogen spectral lines increases in the course of the first stage of the process and by the beginning of the second stage reaches 20 ev. The electron temperature measured by the ratio of the O IV to O V spectral line intensities has approximately the same value. During the second stage of the discharge, the concentration of charged particles in the central region of the column is either maintained approximately constant or increases slightly. The electron density on the periphery of the plasma column is smaller than 10^{12} cm^{-3}. At the same time, an increase of the electron temperature, determined from the plasma electrical conductivity, is observed. Special coils permitted alteration of the configuration of the longitudinal magnetic field in the region of the diaphragms. The influence of these perturbations on the characteristics of the discharge during the various stages of the process was investigated. (auth)

42096 INFLUENCE OF IMPURITIES ON IONIZATION AND HEATING OF DEUTERIUM PLASMA. G. G. Dolgov-Savelev, V. S. Mukhovatov, A. M. Savenkov, and N. A. Yavlinskii (Academy of Sciences, Moscow). Nucl. Fusion, Suppl. 2, Pt. 3: 949-53(1962). (In Russian)

The utilization of pumping-out systems in which no organic substances are used in both high vacuum pumps and in fore-pumps leads to the conclusion that the cracking of heavy hydrocarbons accumulating on the chamber walls are the basic sources of hydrocarbon intrusion into the plasma. Comparative data are given characterizing the plasma obtained in a degassed chamber with an oil-free pumping system as well as in a chamber pumped-out by means of oil-vapor pumps. These results show that in the first case it is possible to diminish considerably the carbon content in the discharge. Measurements of the radiation intensity in the vacuum region of the spectrum that were carried out show that during the first stages of the discharge, even under such conditions, a considerable quantity of the energy being fed into the plasma escapes in the form of radiation. In the subsequent discharge stages the radiation losses diminish considerably. The measurement of the intensity of the carbon lines for a discharge in pure deuterium and in a mixture of deuterium with prepared quantities of methane show that in systems with oil vapor evacuation the concentration of carbon atoms 1 to 2 μsec after the beginning of the discharge is about 20%. In order to clarify the mechanism of energy-loss from the plasma, calculations assuming a Joule-heating model were carried out with an electronic computing machine. The calculations are in agreement with the assumption that in the first stage of development of the discharge the energy is lost due to impurity radiation. A calculation is made of that velocity of intrusion of impurities into the discharge at which there is a balance between the energy fed into the discharge and the energy carried away by radiation. Other possible energy-loss mechanisms are discussed. (auth)

42097 PARTICLE MOTION ON MAGNETIC FLUX SURFACES IN STABILIZED AND HARDCORE PINCHES. D. H. Birdsall, S. A. Colgate, H. P. Furth, C. W. Hartman, and R. L. Spoerlein (Univ. of California, Livermore). Nucl. Fusion, Suppl. 2, Pt. 3: 955-67(1962).

High-power stabilized pinches are subject to magnetic disturbances and leakage of energetic particles. A diffusion theory describing the leakage in terms of interconnection of flux surfaces is consistent with the experimental data. Direct observation of the leakage phenomenon was realized in a 4-in., 100-kamp linear pinch tube, along which is passed a 200-kv, 10-mamp electron beam of 0.1-μsec duration. Prior to onset of magnetic disturbances, the beam delineates regular nested magnetic-flux surfaces at the phosphor end-window. When the beam is injected on a flux surface where magnetic disturbances have begun, the trace becomes erratic, and subsequently all transmission ceases. The loss of beam containment within the pinch begins at the current layer and propagates inward. By addition of a hard core to the pinch tube, suppression of magnetic disturbances can be achieved in inverse stabilized pinches. Correspondingly, regular beam traces are obtainable throughout the pinch cycle, at levels of current density where transmission through stabilized pinches cannot be maintained at all. The

successful containment of particles in hard-core geometry is being given a further test by means of a newly completed 400-kamp levitron (toroidal pinch with ring core) of 12-in. minor diameter. The electron-beam probe proved highly useful for diagnosis of the magnetic structure of pinch discharges even in their stable state. The magnetic pitch on a flux surface can be derived from the angle rotation of the beam image about the pinch axis. The time rate of rotation measures the interdiffusion of magnetic-field components. The magnetic shear can be derived directly from the elongation of the beam image along the flux surface. Experimental tests of this measurement of shear confirm that the results are nearly independent of beam energy and duration, and of absolute magnetic field strength. In stabilized pinches regions of low shear are found prior to onset of the magnetic disturbances. In inverse stabilized pinches substantial shear can be maintained at all radii. (auth)

42098 TURBULENT DISCHARGE IN A LONGITUDINAL MAGNETIC FIELD. B. B. Kodomtsev (Academy of Sciences, Moscow). Nucl. Fusion, Suppl. 2, Pt. 3: 969-77 (1962). (In Russian)

Turbulent plasma convection in a gas discharge with a moderated longitudinal field is considered. It is shown that when the Suydam equilibrium conditions are violated, convective motion consisting of displacement of cylindrical layers with hotter plasma towards the wall, takes place in the plasma. The convective heat transfer across the magnetic field leads to a lowering of the plasma pressure up to several percent of the magnetic field pressure so that the magnetic field configuration becomes practically forceless. The distribution of the longitudinal and azimuthal magnetic fields in such a configuration can be obtained approximately from the condition that the transverse conductivity becomes zero. This distribution is determined from the single parameter $y = 4\pi\sigma Ea|H_0$ where a is the radius of the sheath, σ is the longitudinal conductivity, E is the longitudinal electric field, H_0 is the longitudinal magnetic field on the axis of the discharge. If the parameter y exceeds a certain critical value, then the discharge loses cylindrical symmetry and becomes a screw discharge. Taking into account non-linearity and finite conductivity, the form and amplitude of the screw distortion of the discharge, when y slightly exceeds the critical value, are found. The mechanisms of turbulent energy transfer and the intermingling of the fields are also considered. In particular, the problem of the appearance of a reverse longitudinal field on the periphery of the discharge is discussed. A brief discussion is given of the problem of how the turbulent plasma convection appears and how it changes with increasing longitudinal current over the range of experimental conditions, i.e., from the positive column of an incandescent discharge up to a high-current discharge with a moderated longitudinal field. (auth)

42099 PINCH STABILITY: THEORY AND EXPERIMENT. K. Aitken, R. Bickerton, R. Hardcastle, J. Jukes, P. Reynolds, and I. Spalding (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Fusion, Suppl. 2, Pt. 3: 979-89(1962).

Experimental observations on the stability of various linear hard-core and pinch systems are presented. Although theoretically stable on the ideal hydromagnetic approximation the experimental hard core exhibits instabilities similar to those seen in the pinch. The effect of including finite electrical conductivity is considered theoretically in the two limits of large and small conductivity. In both cases the result is to make the hard-core system unstable. The results of the low conductivity approximation are compared with the behavior of a model hard-core experiment using liquid mercury. The plasma observations are discussed in the light of these extensions to the stability theory. (auth)

42100 EFFECT OF EXTERNAL ELECTRIC AND MAGNETIC FIELDS ON A PLASMA. P. Bertrand and G. Brifford (CEN, Saclay, France). Nucl. Fusion, Suppl. 2, Pt. 3: 991-4(1962). (In French)

The velocity distribution function f_0, denoting the stationary state of a plasma in static magnetic and electric fields, is calculated to the first order by solving the Boltzmann equation in the Lorentz gas hypothesis. The distribution function f_0 so obtained is anisotropic. From this stationary state, a study of the system described by the linearized Boltzmann equation and by the Maxwell equations leads to a dispersion relation. By means of this dispersion relation, the conditions for the existence of the stationary state can be investigated together with the regions of instability. (auth)

42101 STUDY OF DIFFUSION PERPENDICULAR TO A MAGNETIC FIELD. J. F. Bonnal, G. Briffod, M. Grégoire, and C. Manus (CEN, Saclay, France). Nucl. Fusion, Suppl. 2, Pt. 3: 995-9(1962). (In French)

A study was made of the diffusion of a plasma perpendicular to the magnetic field in a weakly ionized medium. Observations reveal three different regimes for the leakage flux, each of which is characterized by a certain region for the magnetic field: 1. For a magnetic field value lower than a certain critical field, the flux diminishes with the magnetic field and increases with the pressure, in accordance with the classical laws of diffusion by binary collision. 2. The leakage flux passes through a minimum at the critical field value. Beyond this value, instabilities appear and the flux begins to increase. In this range the effect of pressure on the flux is different, in that the flux becomes weaker as the pressure is raised, the reverse of the process in 1. 3. After passing through a maximum for a certain high magnetic-field value, the flux begins progressively to diminish for greater field values. The dependence of the flux on the pressure remains the same as in 2. The amplitude of the instabilities diminishes with the magnetic field. This is again an anomalous diffusion dominated by fluctuating electric fields. The study of noise in the unstable regime 2 and 3 reveals components with a frequency higher than the plasma frequency. This last observation and the aggregate of observations made, suggested a tentative theoretical explanation, microscopic in character. (auth)

42102 EXPERIMENTAL STUDY OF A TUBULAR PINCH DISCHARGE. J. Adam, P. Ginot, P. H. Rebut, and A. Torossian (CEN, Fontenay-aux-Roses, France). Nucl. Fusion, Suppl. 2, Pt. 3: 1001-6(1962). (In French)

The perturbations occurring in an unpinch configuration in spite of magnetohydrodynamic stability, the correlation between the turbulence level of the magnetic field and the ion energy, and the validity of the linearity relation ($rB_0 - B_z$) are studied. A 10^{15} ions/cm^3 tubular plasma is formed and confined by two simultaneous discharges: one "unpinch" (hard core pinch) and the other a thetatron type. The period is 150 μsec. The mean equilibrium position is in good agreement with that deduced from calculation of the equality of the magnetic pressures and of the periods of the two discharges. The magnetic wave signals show two stability zones during a half period; slight oscillations then occur. The apparent β (kinetic pressure/magnetic pressure) is 0.4. The current density reaches 0.8 kamp/

cm^2. The linear relation ($rB_0 - B_z$) is verified within the range of experimental error. (auth)

42103 RUNAWAY ELECTRONS IN A TOROIDAL Z-PINCH DISCHARGE IN HYDROGEN. U. Grossmann-Doerth and J. Junker (Max-Planck-Institut fllr Physik und Astrophysik, Munich). Nucl. Fusion, Suppl. 2, Pt. 3: 1007-15(1962).

The x rays produced by runaway electrons in the toroidal discharge experiment T-1 were investigated. The intensity of the radiation as a function of time and energy was measured with the discharge parameters having the following values: electric field strength 5-15 v/cm, pressure 0.02-0.1 torr (hydrogen), B_z-field strength 0-800 G. A burst of radiation was found to appear at the beginning of the discharge with main quantum energy of about 10-20 kev. The radiation during the main part of the discharge is appreciably softer, and the intensity is several orders of magnitude smaller. Similar phenomena were observed in other experiments and are reported. An attempt was made to explain the burst by the rapidly changing particle densities at the beginning of the discharge leading to complete ionization and by the different values of transport cross-section of hydrogen molecules and protons. Whereas the initial burst could be explained in these terms, the small rate of runaway at later times in the discharge as well as the small energies of the electrons seem to call for a process that suppresses the runaway of electrons. Different kinds of instabilities as possible explanation are discussed. (auth)

42104 AN EXPERIMENT IN BEAM-PLASMA INTERACTION IN THE PRESENCE OF A MAGNETIC FIELD. C. Etievant (CEN, Fontenay-aux-Roses, France). Nucl. Fusion, Suppl. 2, Pt. 3: 1025-31(1962). (In French)

The modes of instability excited by electrons streams in a plasma in the presence of a magnetic field are studied. Two experiments are described, one with only one beam of electrons, the other with two beams in opposite directions. This last disposition allows in principle the appearance of standing waves, for example: electron longitudinal waves and ion cyclotron waves. The plasma density fluctuations, the relative amplitude, and the spectrum of the waves were studied. (auth)

42105 INVESTIGATION OF THE DOUBLE-STREAM INSTABILITY. J. Dawson (Princeton Univ., N. J.). Nucl. Fusion, Suppl. 2, Pt. 3: 1033-43(1962).

The development of the double-stream instability and the resultant breakup of the two streams was investigated by following the motion of a one-dimensional plasma (sheet plasma) on a high speed computing machine. The initial state of the plasma was one of two cold interpenetrating electron streams of equal average density on which were superposed random density fluctuations. All Fourier modes were present in the initial density fluctuations so that all unstable modes were excited. It was found that the linearized theory and estimates of when it would break down give a reasonably accurate picture of the initial development of the unstable modes and the level to which they grow. After the modes become nonlinear there is a rapid break up of the two streams and a large part of the energy is converted to random motion. However, the low Fourier modes are found to retain several times the average thermal energy for quite long times after the breakup of the two streams. (auth)

42106 SOME NEW RESULTS ON CONFINEMENT IN MAGNETIC TRAPS. Yu. V. Gott, M. S. Ioffe, and V. G. Telkovskii (Academy of Sciences, Moscow). Nucl. Fusion, Suppl. 2, Pt. 3: 1045-7(1962). (In Russian)

To prevent the escape of plasma an attempt was made to modify the shape of the field so that it increases (from the center of the trap) not only in a longitudinal but also in a radial direction without disturbing the adiabatic properties. A field from a system of conductors was superimposed on the basic field. Since currents in neighboring conductors are opposite, the field has the geometry of cusped traps. The resulting field can be made to increase in a radial direction, however, lines of force far from the axis are distorted so as to cross the wall. It is therefore necessary to create wall mirrors by extending the field of the conductors enough that particles are reflected as at the ends of a trap. Results, which are only preliminary, show that by changing the configuration of the magnetic field one can substantially influence the instabilities that take place. (auth)

42107 NON-LINEAR STABILITY OF PLASMA OSCILLATIONS. W. E. Drummond and D. Pines (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nucl. Fusion, Suppl. 2, Pt. 3: 1049-57(1962).

The collective behavior of a fully ionized plasma in which the number of particles in a sphere of radius a, the Debye length, is very large compared to one is governed by the collisionless Boltzmann or Vlasov equation. In an infinite homogeneous plasma of this type, it is well known that in the linearized theory a velocity distribution $f_0(v)$ consisting of a main part that is a monotonically decreasing function of energy plus a small gentle bump on the tail of the main part (e.g., a Maxwellian plus runaway electrons) leads to unstable (growing) plasma oscillations, and that the unstable oscillations are those for which $v\partial f_0(v)/\partial v > 0$ for $v = \omega/k$ (ω is the frequency and k the wave number). After a sufficient time these waves grow to such an amplitude that the non-linear terms in the Vlasov equation are important and the linearization is no longer valid. The question then arises as to the behavior of these waves in the non-linear region and it is this question that is considered. The method is to divide the non-linear terms into two groups, one of which combined with the linear terms yields a non-linear dispersion relation, while the other provides a weak coupling between the different modes. The non-linear dispersion relation leads to the establishment of an equilibrium spectrum, which then decays slowly to zero due to the mode-coupling terms. The limiting of the wave amplitudes to the equilibrium spectrum is due to flattening of the bump in the velocity distribution by non-linear effects. The slow decay of the equilibrium spectrum leads to further changes in the velocity distribution so that asymptotically the distribution function is a monotonically decreasing function of energy and hence stable. Analytic expressions for the equilibrium spectrum and the equilibrium velocity distribution are obtained. An approximate value for the maximum energy in the equilibrium electric field is given by the geometric mean of the thermal energy and the drift energy of the particles in the bump. (auth)

42108 EXPERIMENTAL STUDY OF MAGNETO-ACOUSTIC RESONANCE. A. V. Bartov, E. K. Zavoiskii, I. A. Kovan, B. I. Patrushev, V. D. Rusanov, and D. A. Frank-Kamenetzkii (Academy of Sciences, Moscow). Nucl. Fusion, Suppl. 2, Pt. 3: 1067-71(1962). (In Russian)

The experiments were made under linear and essentially non-linear conditions. In the linear experiments, carried out in a plasma prepared by an external source, the resonance was excited by a low-power instrument generator whose influence on the concentration of the plasma could be neglected. Thereby the parameters of the plasma (concentration, size of the column, magnetic field) were constant

within the framework of the experiment or were strictly controlled, which is essential for the clarification of the physical picture of the phenomenon. The experiments were carried out at values of plasma concentration from 10^{10} to 4×10^{13} cm^{-3}. In the majority of experiments the magnetic field constituted 1 to 2×10^3 G. The resonance was excited within the range of frequencies from a few to about 200 MHz by an excitation device in the form of an elongated ring and the resonance was recorded with respect to the variation of the Q of the measuring circuit and according to the magnetic-probe date. With the help of magnetic probes the spatial distribution of the varying magnetic fields in the plasma at resonance were also measured. These measurements allow the determination of the values k_r and k_z and indicate the amplification (at resonance) of the varying magnetic field in the plasma. The concentration in the plasma was controlled with the help of middle-high frequency methods as well as by double electric probes. The dependence of the resonance frequency on the concentration of plasma and on the magnitude of the magnetic field strength, which were experimentally observed, confirms the conclusions of the theory. However, qualitative measurements of the plasma show that apparently the energy dissipation is not explained by the simplest collision mechanisms. The non-linear experiment, in which the plasma was created by the same device in which the resonance was studied, is complicated (the resonance being observed at varying plasma parameters — concentration and column dimension) but it is of practical interest mainly as an effective method of plasma creation. The investigation of the resonance in non-linear conditions allowed the determination of the power absorption by the plasma and the temperature of the plasma electrons. Thus, for excitation of the resonance by a 100-MHz generator and a nominal power of 300 kw, the absorbed power constituted about 180 kw. In this experiment, $H = 7 \times 10^3$ G and the concentration of the charged particles $n \approx 2 \times 10^{13}$ cm^{-3}. In these experiments the electron temperature is determined from observation of the intensity of the lines $\lambda = 3889$ and 5016 Å and is found to be $T_e = 15$-20 ev. These values are confirmed by experimental measurements showing the presence of the impurity lines O^+ and N^+ and the absence of He^+ lines. The degree of ionization at the resonance approached 100%. The measured plasma quality factor (Q) turned out to be equal to about 20, whereas theoretical evaluation yields Q = 240. This shows that in this case it is insufficient to consider merely the simplest mechanisms. (auth)

42109 ABSORPTION BY A PLASMA OF THE ENERGY OF VARYING LARGE-AMPLITUDE ELECTROMAGNETIC FIELDS. M. V. Babykin, E. K. Zavoiskii, L. I. Rudakov, and V. A. Skoryupin (Academy of Sciences, Moscow). Nucl. Fusion, Suppl. 2, Pt. 3: 1073-7(1962). (In Russian)

Varying electromagnetic fields, excited in plasma, induce electric currents in it. If the relative velocity v of the charged particles of plasma exceeds their thermal velocity, then instability may develop in the plasma, leading to the slowing-down of the electron component of the plasma by the ions. This is the well known instability of an electron beam. This type of collective effect of necessity expresses itself in the fact that velocity of the current cannot greatly exceed the thermal velocity of electrons. Owing to this, the energy of the field will be irreversibly transferred to the electrons of the plasma. This is a threshold effect. For optimum conditions of instability, it is necessary that the density of electromagnetic energy should exceed the plasma pressure. An experiment was conducted in order to test the above considerations. The plasma was prepared by direct discharge, and a high-frequency magnetic field with a voltage of up to 750 G was created by an oscillatory circuit consisting of a single-turn inductance coil and a capacitance. The density of the plasma attained 2×10^{13} cm^{-3}, and the frequency of the circuit changed from 8 to 13 MHz. With the parameters selected, the ionization time was greater than 0.5×10^{-6} sec. For a time interval of the order of the oscillation period the plasma absorbed energy from the circuit. The growth in concentration of the plasma after operation of the circuit can be explained only on the hypothesis that during operation of the circuit (10^{-7} sec) the electrons of the plasma were storing energy sufficient for subsequent ionization. (auth)

42110 EXPERIMENTS ON ION CYCLOTRON WAVES. W. M. Hooke, P. Avivi, M. Brennan, M. A. Rothman, and T. H. Stix (Princeton Univ., N. J.). Nucl. Fusion, Suppl. 2, Pt. 3: 1083-7(1962).

Measurements were made of the wavelengths of ion cyclotron waves propagating along magnetic lines of force into a region of decreasing field intensity; i.e., the magnetic beach geometry. Shielded magnetic probes were used for these measurements. Simultaneous measurement of the wavelength, frequency of oscillation, electron density, and magnetic field allowed a comparison of experimental results with the theoretical dispersion relations. The free electron density ranged from around 3×10^{12} to 3.5×10^{13} cm^{-3} and the magnetic field from 22 to 27 kG. The measured wavelengths varied from around 15 to 60 cm. These results appear to be consistent with the theoretical dispersion relations. In addition, the magnetic probes were used to measure the power carried by the ion cyclotron waves along the lines of force, yielding a flux of 100 kw. (auth)

42111 RADIOFREQUENCY EMISSION FROM PLASMAS NOT IN THERMODYNAMIC EQUILIBRIUM. S. C. Brown and G. Bekefi (Massachusetts Inst. of Tech., Cambridge). Nucl. Fusion, Suppl. 2, Pt. 3: 1089-99(1962).

Calculations of the propagation constant of a plane electromagnetic wave in a tenuous unbounded plasma show that under suitable conditions the wave grows exponentially in amplitude. For this to happen the population of electrons should increase with increasing energy and the emission cross-section for the process must decrease sufficiently rapidly with increasing energy. Detailed calculations of the rate of amplification and the range of frequencies in which it occurs are given for bremsstrahlung and cyclotron emission. Amplification of bremsstrahlung occurs in plasmas of low ionization and for low electron energies. Amplification of cyclotron emission is particularly favorable in highly ionized, high-energy plasmas. Here even small departures of the electron distribution of energies from a Maxwellian distribution lead to a very significant increase of cyclotron emission. Experiments, designed to measure the amplification of cyclotron emission, are described. (auth)

42112 INTERACTION OF AN ELECTRON BEAM WITH A PLASMA IN A MAGNETIC FIELD. I. F. Kharchenko, Ya. B. Fainberg, R. M. Nikolaev, E. A. Kornilov, E. I. Lutsenko, and N. S. Pedenko (Academy of Sciences, Moscow). Nucl. Fusion, Suppl. 2, Pt. 3: 1101-6(1962). (In Russian)

Results of the experimental investigations on the interaction between a modulated or unmodulated electron beam and plasma in a magnetic field are presented. The conditions of the onset of instabilities in the beam-plasma system are determined with respect to their dependence on

beam velocity, plasma density, and magnetic field strength. A high-frequency excitation (in the range 2000-8000 MHz) and low-frequency (in the range 1 kHz to 10 MHz) oscillations in the regions of instability were observed. The spectrum of the excited particles and the period of the instability development were measured. The loss of energy by the beam electrons caused by the excitation of oscillations was measured. The plasma energy increase occurring with the excitation of oscillations was also determined. The development of instabilities is accompanied by a diffusion of the ions and electrons across the magnetic field. The modulation of the beam at a frequency of 3000 MHz leads to the suppression of a whole spectrum of instabilities due to the fact that a wavelength not coinciding with the resonance wavelength is imposed on the system. Thus only the narrow instability regions caused by parametric excitation remain. The experimental measurements confirm the theoretical assumptions concerning the onset of self-modulation in the beam that passes through the plasma and concerning the presence of a coherent interaction between the electron beam and the plasma. (auth)

42113 SOME STABLE PLASMA EQUILIBRIA IN COMBINED MIRROR-CUSP FIELDS. J. B. Taylor (United Kingdom Atomic Energy Authority, Abingdon, Berks, Eng.). Phys. Fluids, 6: 1529-36(Nov. 1963). (CLM-P-22)

The problem of equilibrium and stability of plasma confined in certain magnetic fields of combined mirror-cusp form is discussed. These fields have the properties that they are nowhere zero and everywhere increase toward the periphery. Attention is drawn to the importance of the existence of closed surfaces of constant $|B|$, the magnetic isobars. The conditions for plasma equilibrium are derived and interpreted; then by exploiting the existence of closed magnetic isobars certain low-β confined equilibria are constructed. These equilibria are shown to be stable according to the fluid (double adiabatic) energy principle and according to the small Larmor radius limit theory. A direct proof of stability against motions that preserve the magnetic moment is given. These equilibria have the property that there is no current along lines of force so that they are also immune to several drift instabilities. (auth)

42114 OBSERVATION OF PLASMA INSTABILITY WITH ROTATIONAL EFFECTS IN A MIRROR MACHINE. W. A. Perkins and R. F. Post (Univ. of California, Livermore). Phys. Fluids, 6: 1537-58(Nov. 1963). (UCRL-7302)

Two types of hot plasmas were produced and confined between magnetic mirrors by plasma injection followed by slow magnetic compression in the Table Top III device: (1) a "hot-electron plasma," in which the plasma was highly compressed and the electron temperature was 10 to 25 kev, and (2) a "hot-ion plasma" in which the compression was less but the ions were hotter than the electrons. In both cases, regimes could be found in which gross instability occurred. The plasma column was observed to leave the axis and spiral, as a whole, outward to the chamber walls with a radial velocity of about 5×10^5 cm/sec. On the basis of the observations and a comparison with theory this behavior is interpreted as a simple azimuthal mode number M = 1 interchange instability accompanied by a rotation arising from the fact that the plasma has a net charge. No multiple flutes (M > 1) were observed during this motion, although occasionally simultaneous existence of two plasma columns was detected. The lower critical density for the onset of the instability was approximately that density for which the Debye distance was equal to the plasma diameter. Stabilized regimes were also obtained by operation with high injected densities or at higher base pressures and the plasma remained confined for many milliseconds. There was also an intermediate regime in which instability could be deliberately triggered by a finite electrostatic perturbation in a plasma that had been quiescent for milliseconds. Some aspects of the observed stabilization, particularly the nonobservance of multiple flutes, occurring under conditions in which simple hydromagnetic theory predicts instability for all values of M > 0, seem to be explainable in terms of a finite-orbit theory, although other effects seem also to be present. (auth)

42115 NONADIABATIC INJECTION INTO A STATIC MIRROR FIELD. D. L. Lafferty and B. N. A. Lamborn (Univ. of Florida, Gainesville). Phys. Fluids, 6: 1559-65 (Nov. 1963).

An analysis is made of a conservative trapping mechanism in a static mirror field. The discussion is specialized to the tangential injection of particles in the midplane. The analysis is based on single-particle dynamics in a conservative system. The adiabatic conditions are violated in two distinct ways: A random exchange of energy between transverse and longitudinal motion can occur due to fast characteristic loops in the particle trajectory; a second-harmonic angular perturbation in the midplane field produces parametric resonance in the longitudinal degree of freedom and results in energy transfer from transverse to longitudinal motion. Energy tends to be absorbed in the longitudinal degree of freedom until the resonance conditions are no longer satisfied. This tendency toward the accumulation of energy in longitudinal motion arises from the asymmetry of the equations of motion; energy is transferred to longitudinal motion by virtue of an unstable solution of the Mathieu equation and in the opposite direction by ordinary resonance. Computer studies of the coupled nonlinear equations of motion of a single particle verify the analytic prediction of rapid growth of the longitudinal oscillation. (auth)

42116 SINGLE-PARTICLE CYCLOTRON RADIATION NEAR WALLS AND SHEATHS. Albert Simon and Marshall N. Rosenbluth (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 6: 1566-73(Nov. 1963).

A particle, which moves perpendicular to a magnetic field while undergoing periodic elastic collisions with a rigid wall, emits radiation that is rich in higher harmonics. Collisions with a sheath, instead of a wall, also produces radiation of this sort. The resulting radiation is calculated utilizing a simplified model of a sheath and also assuming an exponential plasma density distribution, and is then compared with experiment. The observed spectral shape or the observed intensity can be fitted separately, but a simultaneous fit is rather difficult. The best results are obtained for a sheath thickness of the order of a Debye length. (auth)

42117 ONSAGER PHENOMENOLOGICAL COEFFICIENTS FOR A WEAKLY IONIZED CESIUM PLASMA. Lawrence Baylor Robinson (Univ. of California, Los Angeles) and Robert Carroll Beaty. Phys. Fluids, 6: 1578-80 (Nov. 1963).

The Onsager phenomenological coefficients are calculated for coupled electrical and thermal fluxes in a weakly ionized cesium plasma, when the only collisions of importance are those between electrons and neutral atoms. The phenomenological coefficients are converted into isothermal electrical conductivity, thermal conductivity in the absence of an external electric field, and in the presence of an external electric field. Numerical values of the ratio of the thermal

conductivity to the product of temperature and electrical conductivity compare closely with the theoretical Wiedemann–Franz ratio. (auth)

42118 SOLUTION OF THE VLASOV EQUATIONS FOR A PLASMA IN AN EXTERNALLY UNIFORM MAGNETIC FIELD. Richard B. Nicholson (Univ. of Wisconsin, Madison). Phys. Fluids, 6: 1581-6(Nov. 1963).

An exact solution is presented of the collisionless Boltzmann equation that describes a slab of plasma contained in a magnetic field that is uniform external to the slab. The magnetic field dips in the plasma due to the diamagnetic currents in the plasma sheath separating the region of nearly constant density from the vacuum region. The currents are given by the distribution functions for ions and electrons and the fields obey Maxwell's equations. The solution has the qualitative features of real collisionless laboratory plasma distributions. The problem of a cylindrical plasma with axial magnetic field is also treated, and a solution presented for a limiting case. The solution to the slab problem is charge neutral. The limiting case in the cylindrical problem is also charge neutral, but the general cylindrical problem is not, and contains radial electric fields. The solutions have the merit of being substantially more simple than others that have previously been found for the plasma sheath problem. (auth)

42119 EFFECT OF A HELICAL FIELD ON THE PLASMA BEHAVIOR IN THE MODEL C STELLARATOR. Wynford L. Harries, Shoichi Yoshikawa, and Rolf M. Sinclair (Princeton Univ., N. J.). Phys. Fluids, 6: 1591-8 (Nov. 1963). (MATT-171)

The superposition of an l = 3 helical field on the uniform confining magnetic field of the Model C Stellarator introduces a rotational transform of up to 58° at 5 cm radius. Measurements were made of the effect on the plasma of superimposing this helical field on the confining field. If the confining field of the stellarator is made symmetric (if each line of force is closed when no helical field is applied), superimposing the helical field improves plasma equilibrium and increases the plasma temperature and particle confinement time. When the rotational transform from the Ohmic heating current is in the opposite sense to that from the helical winding, such that the net transform near the outer edge of the plasma is zero, a rapid loss of plasma occurs. The effect of a deliberately introduced lack of closure in the vacuum field is minimized by the helical field. (auth)

42120 HALL CURRENTS AND VORTICES IN THE COAXIAL PLASMA ACCELERATOR. W. H. Bostick (Stevens Inst. of Tech., Hoboken, N. J.). Phys. Fluids, 6: 1598-1603(Nov. 1963).

The fact that the current sheet in a coaxial plasma accelerator is planar with the center conductor negative, and bullet-shaped when the center conductor is positive can be at least partially explained by a combination of Hall currents and plasma vortices, both of which should be expected to occur in such an accelerator. This explanation asserts that the peculiar asymmetrical behavior of this accelerator is a consequence of the fundamental property of ordinary-matter plasma; that electrons are light and positive ions are heavy. The sign of the asymmetry would be changed if antimatter plasma were employed. It is doubtful whether a planar current sheet could be achieved with a positronium plasma. (auth)

42121 WAVE PATTERNS IN A SUPERSONIC PLASMA FLOW PERVADED BY A UNIFORM MAGNETIC FIELD. Koichi Oshima (Univ. of Southern California, Los Angeles). Phys. Fluids, 6: 1655-6(Nov. 1963).

A small wind tunnel was used to produce a supersonic flow of partially ionized nitrogen in the presence of a cross magnetic field, and the flow field around a thin, blunt-nosed, flat-plate model was observed optically. An electric field was applied in order to ionize the gas slightly by glow discharge. (R.E.U.)

42122 COLLISIONLESS PLASMA-SHEATH IN CYLINDRICAL GEOMETRY. Jerald V. Parker (California Inst. of Tech., Pasadena). Phys. Fluids, 6: 1657-8(Nov. 1963).

The electron density and potential in a low-density (long mean free path) plasma is solved for cylindrical geometry, with solutions valid through the sheath region. (R.E.U.)

42123 RELATIVISTIC CORRECTIONS TO MICROWAVE INTERFEROMETRY IN PLASMAS. H. W. Graben (Oak Ridge National Lab., Tenn.). Phys. Fluids, 6: 1659-60(Nov. 1963).

The index of refraction for a plasma with a high electron temperature was calculated for plane, transverse waves having frequencies large compared to the plasma frequency and to the electron cyclotron frequency. Results indicate that microwave phase-shift measurements of the plasma density based on the cold plasma relation for the index of refraction tend to be too small at high temperatures ($T > mc^2$). (R.E.U.)

42124 HALL ROTATION IN THETA-PINCHES. M. G. Haines (Imperial Coll. of Science and Tech., London). Phys. Letters, 6: 313-14(Oct. 1, 1963).

It is shown that the Hall effect provides a mechanism that can cause the rotation of theta pinches. A theta pinch with a superposed multipole field generated by Ioffe bars and an ordinary theta pinch are considered separately. (R.E.U.)

42125 ELECTRON ENERGY DISTRIBUTIONS IN PLASMAS. V. A SEARCH FOR EVIDENCE OF A HIGH ANOMALOUS RATE OF ENERGY EXCHANGE BETWEEN THE ELECTRONS OF A LOW-PRESSURE DISCHARGE. N. D. Twiddy (University Coll., London). Proc. Roy. Soc. (London), Ser. A, 275: 338-56(Oct. 8, 1963).

Since earlier measurements of electron energy distributions obtained with the Druyvesteyn probe method showed no evidence of the scattering observed in mercury by Langmuir (1925) and Merrill & Webb (1939), the method was used to examine discharges in hydrogen, neon, krypton, and mercury in a search for evidence of such a high rate of energy exchange between the electrons. This was observed in neon when, as the discharge current was increased, the well-defined group of primary electrons from the filament disappeared, giving rise to a uniform distribution. In krypton and mercury, the distribution near the filament was usually uniform, although frequently there was evidence of a strongly broadened primary group and electrons were often observed with energies greater than the potential difference between the filament and the measuring probe. This behavior is almost certainly to be explained in terms of Langmuir scattering near the filament, but the scattering was always restricted to regions very close to the filament and was never observed in the positive column. After the initial scattering the distribution is influenced by the applied field in a similar manner to that observed in earlier measurements and in these gases, although the distribution is quite uniform near the filament, there are very marked departures from uniformity further from the cathode as the distribution is accelerated in either a uniform field or through a step of potential, giving rise to well defined primary and secondary groups of electrons. These newly created primaries are not scattered. Measurements in high-field regions in krypton show a high ratio of pri-

mary to secondary electrons. This is due to the pronounced Ramsauer effect in this gas and was observed earlier in argon. The change of energy distribution resulting from the contamination of a discharge in neon by argon and mercury was investigated. (auth)

42126 DEPENDENCE OF DIFFUSION OF PLASMA ON MAGNETIC FIELD AND PRESSURE AND ON THE LONGITUDINAL EXPANSION IN MAGNETIC FIELD DIRECTION. F. Schwirzke (Institut für Plasmaphysik, Garching, Ger.). Z. Naturforsch., 18a: 889-95(Aug.-Sept. 1963). (In German)

The radial density distribution for a plasma in a uniform magnetic field was studied in dependence of pressure and distance of the conducting end plates. It was possible to confirm experimentally the dependence of the radial distribution of the finite length in direction of the field lines. The influence of the magnetic field, of the pressure, and of the length of the plasma column on the radial density profile is, in different gases, qualitatively in accordance with the "short-circuiting" theory of A. Simon. (auth)

42127 THE CHANGE WITH TIME OF THE RADIAL ELECTRON DENSITY DISTRIBUTION IN THETA PINCH. Franz Peter Kuepper (Institut für Plasmaphysik, Garching, Ger.). Z. Naturforsch., 18a: 895-900(Aug.-Sept. 1963). (In German)

In a Θ-pinch the radial symmetry of the electron density distribution as a function of time was measured by a Mach–Zehnder interferometer. In a time interval of 400 nsec during a discharge an image converter made three pictures (exposure times of 10 nsec each). Up to 100 nsec after the first compression, the experimental results showed different density distributions for the cases of trapped parallel and antiparallel magnetic fields. Complete radial symmetry of the electron density distribution was not found. Another interferometric method for measuring the radial symmetry of the electron distribution by observing "zero order" fringes is described. (auth)

42128 USE OF A TRITIUM ION BEAM FOR DETERMINATION OF THE DENSITY OF A DEUTERIUM PLASMA. B. M. Gokhberg, I. K. Kikoin, A. S. Knyazyatov, V. V. Maltsev, and G. A. Otroshchenko. Zh. Eksperim. i Teor. Fiz., 45: 428-36(Sept. 1963). (In Russian)

A method is developed for probing a deuterium plasma with a tritium ion beam in which neutrons from the T + D reaction are recorded. The method is applied for investigating density changes in the plasma of a toroidal discharge in a weak magnetic field. The plasma density is found to increase compared to the initial density of the operating gas. From the experiments it can be concluded that the increase of plasma density observed is due to liberation of gas from the chamber during the discharge. (auth)

42129 NONLINEAR THEORY OF DRIFT INSTABILITY OF AN INHOMOGENEOUS PLASMA IN A MAGNETIC FIELD. A. A. Galeev and L. I. Rudakov (Novosibirsk State Univ., USSR). Zh. Eksperim. i Teor. Fiz., 45: 647-55 (Sept. 1963). (In Russian)

A weakly turbulent plasma is considered, the turbulency being due to instability of the inhomogeneous plasma. The effect of self-inhibition of the instability by the oscillations due to it is considered. It is shown that this type of instability is important only for a collision plasma. The nonlinear increment is estimated. The stationary oscillation spectrum is calculated by means of the kinetic equation for waves. In this way turbulent flow of the plasma across the confining magnetic field can be estimated. Although the turbulent diffusion coefficient thus computed is greater than the classical value, it is nevertheless small compared with the Bohm coefficient. (auth)

42130 ON THE PROBABILITY OF UNSTABLE PLASMA. V. P. Silin (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 816-18(Sept. 1963). (In Russian)

The principle of plasma instability in relation to the particle population level inversion was investigated for the case in which the velocities differ considerably from field oscillation velocities. It is shown that the electromagnetic oscillation instability may take place in any inverted population media, however, in such event the quantum stability concept should be considered. The described instability occurs only with large oscillation amplitudes and are possible only with nonlinear perturbations. A detailed analysis of such instability would require detailed studies of additional dissipative processes and detailed excitation spectra. (R.V.J.)

42131 STANDING MAGNETO-PLASMIC WAVES IN BISMUTH RELATED TO HYBRID RESONANCE. V. S. Edel'man and M. S. Khaikin (Inst. of Problems in Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 45: 826-8(Sept. 1963). (In Russian)

Magneto-plasmic waves in reactive surface resistance oscillations were examined using two disc-shaped, 18-mm diameter bismuth monocrystals, one 0.47 and the other 0.39 mm thick. A method of frequency modulation at frequencies to 9.7 Bc and 1.7°K temperature was used. The results for frequencies from 8.91 to 9.51 Bc showed a nonlinear dispersion law. With a temperature drop from 3.3 to 1.7°K the oscillation amplitude in the 0.47 mm specimen increases seven fold. The presence and properties of magneto-plasmic waves in bismuth are in agreement with theoretical data presented by G. E. Smith et al. (Phys. Rev., 129: 154(1963)). (R.V.J.)

42132 INVESTIGATION OF PLASMA DECAY IN TOROIDAL MAGNETIC FIELD. V. E. Golant, O. B. Danilov, and A. P. Zhilinskii (Leningrad Polytechnic Inst.). Zh. Tekhn. Fiz., 33: 1043-54(Sept. 1963). (In Russian)

Results are given of theoretical and experimental investigations on the decay of weakly ionized plasma in a torus with a longitudinal magnetic field. Theoretical equations were developed for plasma decay, plasma concentration, and concentration variability with time. Experimental data were found for various time dependent changes in particle concentration in helium-filled tori. Experimental and theoretical data on magnetic field drift effects are in agreement. (tr-auth)

42133 VISUAL STUDIES OF PLASMA CLUSTERS. K. D. Sinel'nikov, B. G. Safronov, V. G. Podalka, and I. I. Demidenko. Zh. Tekhn. Fiz., 33: 1055-8(Sept. 1963). (In Russian)

Descriptions are given of a device for visual plasma cluster studies. The behavior of plasma clusters moving through homogeneous longitudinal and toroidal fields was investigated. The feasibility of hydrogen plasma purification from heavy ion admixtures during cluster motion in toroidal fields was analyzed. (tr-auth)

42134 ON THE APERIODIC INSTABILITY OF RELATIVISTIC PLASMA. S. S. Moiseev. Zh. Tekhn. Fiz., 33: 1059-65(Sept. 1963). (In Russian)

Aperiodic instability of relativistic plasma in an external magnetic field and nonlinear conditions in a weak magnetic field induced by the aperiodic instability are analyzed. It is shown that the thickness of collisionless shock waves in a weak magnetic field can be smaller than in the non-

relativistic case. The influence of weak fields and pair coincidences on the development of nonlinear conditions diminishes with increased electron energy. (tr-auth)

42135 INTERACTIONS OF ELECTRON BEAMS WITH PLASMA IN A MAGNETIC FIELD. M. F. Gorbatenko (Inst. of Physics and Tech., Khar'kov). Zh. Tekhn. Fiz., 33: 1070-9(Sept. 1963). (In Russian)

Interactions of a limited electron-ion beam with an unconfined electron-ion plasma in an external constant magnetic field were analyzed. Accumulation increments and excitation of slow ($V_f \ll C$) waves (V_f is the phase wave velocity) in the Doppler and Cherenkov excitation mechanisms were found. Studies were also made of wave excitation propagating perpendicular to the beam velocity. (R.V.J.)

42136 PLASMA Θ PINCH IN A MAGNETIC NET. Ya. F. Volkov, V. T. Tolok, and S. M. Krivoruchko. Zh. Tekhn. Fiz., 33: 1093-7(Sept. 1963). (In Russian)

An attempt was made to stabilize and confine a hot Θ pinch by creating a magnetic net with gaps distributed parallel to the discharge chamber axis. The confining ability of the net and the stability and purity of the pinch with and without a $B\varphi$ field were analyzed. The results showed that the life of a plasma in a given net is proportional to $B\varphi^{1.5}$. The life of a plasma with a particle density of 6×10^{13} cm^{-3} is 70 μsec in a 3 kc $B\varphi$ field. The experiments showed that the net had a stabilizing effect on a Θ pinch and reduced the influx of impurities from the discharge chamber walls. (R.V.J.)

42137 ELECTRON MOTION IN SPACE-PERIODIC HELICAL MAGNETIC FIELDS. R. A. Demirkhanov, Yu. V. Kursanov, D. G. Baratov, and G. V. Kharin. Zh. Tekhn. Fiz., 33: 1098-1103(Sept. 1963). (In Russian)

Electron motion in a magnetic field prepared by the superimposition of longitudinal, transverse, space-periodic, helical magnetic fields was investigated. A resonance redistribution of energy between the longitudinal and transverse components was observed at certain ratios between charged particle energy, helical winding space, and longitudinal and transverse magnetic field. (tr-auth)

42138 ACCELERATION OF PLASMA BY HIGH FREQUENCY FIELD. M. L. Iovnovich. Zh. Tekhn. Fiz., 33: 1116-20(Sept. 1963). (In Russian)

Combined acceleration of electron and ion components in a high-frequency field and interactions of plasma clusters with the plasma flux were investigated. (tr-auth)

42139 ON FLUTED INSTABILITY OF A ROTATING PLASMA CYLINDER. Yu. V. Vandakurov. Zh. Tekhn. Fiz., 33: 1134-7(Sept. 1963). (In Russian)

Ordinary magnetohydrodynamic equations were used in an investigation of instability along a cylindrical magnetic field in a rotating plasma cylinder. The relation of weak plasma-magnetic pressure was resolved considering perturbations as functions of the distance (r). The results are not in agreement with B. Lehnert's (Phys. Fluids, 5: 740 (1962)) contention that the dependence of perturbations on (r) is negligible. (R.V.J.)

42140 ON A NONLINEAR EQUATION DESCRIBING PLASMA DECAY IN MAGNETIC FIELD. V. E. Golant and G. A. Grinberg (Ioffe Inst. of Physics and Tech., Leningrad) Zh. Tekhn. Fiz., 33: 1139-41(Sept. 1963). (In Russian)

A previously obtained solution, based on nonlinear equation approximation, for particle concentration in decaying plasma was found to be erroneous. Another solution was derived under a condition in which transverse diffusion induced by electron-ion collisions and square electron-ion recombinations are the principal process eliminating charged particles in strong magnetic fields. Under the latter conditions the equation for plasma decay in a cylinder with a magnetic field along the axis is $\partial n/\partial t = \gamma(1/r)(\partial/\partial r)[rn(\partial n/\partial r)] - \alpha n^2$, where n is the concentration of charged particles, $D_{ei} = \gamma n$ is the coefficient of charged particle diffusion across the magnetic field, α is a recombination coefficient, and γ and α do not depend on particle concentration. The concentration of charged particles near the cylinder walls (at r = a) is assumed to be zero. (R.V.J.)

42141 DETERMINATION OF VOLUME ELECTRON ELIMINATION COEFFICIENTS IN PLASMA DECAY IN OXYGEN. A. I. Anisimov, N. I. Vinogradov, and V. E. Golant (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 33: 1141-3(Sept. 1963). (In Russian)

The recombination coefficient and mean frequency of electron capture by oxygen molecules were studied at 0.05 to 0.2 mm Hg with charged particle concentrations of 10^{10} to 5×10^{11} cm^{-3}. A 250-mm long, 5-mm diameter cylinder with a strong magnetic field along the axis was used in order to eliminate the effects of particle diffusion into the cylinder walls. The magnetic field intensity varied to 8000 gauss. The influence of charged particle diffusion on plasma decay was negligible in the above fields, and elemination of electrons resulted from volume processes (electron-ion recombination and electron capture by oxygen). The coefficient electron volume elimination, $\beta = (1/\bar{n})(d\bar{n}/dt)$, was determined by the electron concentration curves. The curves of β as a function of oxygen pressure and mean concentration was expressed by $\beta = \nu_{e0}p + \alpha\bar{n}$, where $\nu_{e0} = (9 \pm 1) \times 10^{-4}$ mm Hg^{-1} sec^{-1}, and $\alpha = (1.9 \pm 0.1) \times 10^{-7}$ cm^3 sec^{-1}. (R.V.J.)

42142 MOBILITY AND SCATTERING CROSS SECTIONS OF CESIUM IONS IN A WEAKLY IONIZED CESIUM PLASMA. N. D. Morgulis and Yu. P. Korchevoi (Kiev State Univ.). Zh. Tekhn. Fiz., 33: 1146-8(Sept. 1963). (In Russian)

Ionic mobility and effective electron scattering cross sections were investigated in weakly ionized cesium plasma with positive cesium ions. (R.V.J.)

42143 MAGNETOHYDRODYNAMIC EFFECTS ON STAGNATION-POINT HEAT TRANSFER FROM PARTIALLY IONIZED NONEQUILIBRIUM GASES IN SUPERSONIC FLOW. J. B. Wilkinson (AeroChem Research Labs., Inc., Princeton, N. J.). 32p. (CONF-101-2)

From 3rd Annual Symposium on Engineering Aspects of Magnetohydrodynamics, Rochester, N. Y., Mar. 1962.

The effects of dipole-like magnetic fields on stagnation-point heat transfer to a blunt, axisymmetric body in supersonic, nonequilibrium plasma streams were studied experimentally. Methods of characterizing the gaseous stream, both aerodynamically and electrically, are described. To determine the extent to which the classical continuum magnetohydrodynamic model can predict energy transfer rates in ionized gas streams, heat-flux data is reported as a function of the conventional MHD interaction parameter. This parameter is shown to yield inadequate correlation in the regimes covered, suggesting that important extensions of the MHD model are still needed before reliable predictions of energy-transfer rates from ionized gases at low densities in regions of high magnetic-field strengths can be made. (auth)

42144 RADIATION LOSSES FROM HIGH-TEMPERATURE GAS DISCHARGES. Alan C. Kolb (Naval Research Lab., Washington, D. C.). 24p. (CONF-248-1)

From Symposium on Quantitative Spectroscopy and Applications in Space Science, Pasadena, Calif., Mar. 1963.

Numerical calculations are presented for the impurity-radiation losses and cooling of a deuterium plasma produced by high-current electrodeless discharges in low-inductance, single-turn coils (theta pinches). Available experimental data are used to make a semiquantitative comparison with theory. These calculations are of preliminary nature and only serve to indicate the influence of radiative energy losses on the hydromagnetic behavior of the plasma. (R.E.U.)

42145 BOUNDARY VALUE PROBLEMS IN PLASMA OSCILLATIONS: THE PLASMA CAPACITOR. Fred C. Shure (Univ. of Michigan). 33p. (CONF-22-28)

From American Physical Society 1963 Annual Meeting, New York, Jan. 1963.

A normal mode treatment is proposed for the solution of boundary value problems in plasma oscillations. The plasma distribution function and electric field are expanded in terms of the solutions of the coupled Vlasov and Maxwell equations. These normal mode solutions are somewhat unusual in that they are singular functions of the velocity variable, and, in fact, the expansion theorem is proved by means of a direct solution of an associated singular integral equation. As an application of the method, the impedance of a plasma-filled parallel plate condenser is obtained. (auth)

42146 THE EFFECT OF ELECTRIC AND MAGNETIC FIELDS ON ELECTRON HEAT TRANSFER. Donald L. Turcotte (Cornell Univ., Ithaca, N. Y.). New York, American Institute of Aeronautics and Astronautics, 1963. Preprint 63-461, 10p, $1.00. (CONF-240-1)

From American Institute of Aeronautics and Astronautics Conference on Physics of Entry into Planetary Atmospheres, Cambridge, Mass., Aug. 1963.

A set of equations is obtained for the stagnation point boundary layer in an ionized monatomic gas. It is assumed that the ion and electron temperatures are equal so that only a single energy equation is required. However, a pair of conduction equations are written so that sheath effects can be studied. Appropriate nondimensional variables are introduced. The equations are decoupled and solutions for the velocity and ambipolar diffusion are given. An approximate method for determining the sheath structure is given and is compared with a numerical solution. The dimensionless sheath thickness is determined and is compared with the boundary layer thickness for several typical stagnation point flows. The effect of applied electric and magnetic fields on the electron heat transfer is discussed. It is concluded that a positive wall potential to reduce the flux of ions to the wall offers more promise for reducing the total heat transfer than a negative potential which excludes electrons from a portion of the thermal boundary layer and thereby reduces the electron contribution to the thermal conductivity. A magnetic field of sufficient strength to make $\omega_e\tau_e$ of order one reduces the electron contribution to the thermal conductivity but does not affect the diffusion of ion-electron pairs to the wall. If $\omega_i\tau_i$ is of order one the diffusion of charged particles to the wall is reduced. However, experiments in discharge tubes indicate that such a situation may be unstable. (auth)

42147 TRANSPORT EQUATION FOR A PLASMA INTERACTING WITH THE ELECTROMAGNETIC FIELD. C. A. Roberts (Long Beach State Coll., Calif.) and S. Katz. 21p. (CONF-78-14)

From American Physical Society 1963 Summer Meeting, Buffalo, June 1963.

The evolution equation for a plasma that consists of charged particles interacting by Coulomb's Law is the Balescu-Lenard equation. This equation is generalized to include the effects of the electromagnetic field. This has previously been done; the difference between the method used and others is that the elimination of terms proceeds at a later stage in the calculation and by a different method. The entire calculation is classical ($\hbar = 0$). The calculation starts with the Liouville equation for charged particles interacting through the electromagnetic field. The Liouville equation is then solved in the framework of the resolvent formalism. (auth)

42148 HARMONIC GENERATION AND PARAMETRIC OSCILLATIONS IN A PLASMA DISCHARGE. J. H. Krenz and G. S. Kino (Stanford Univ., Calif.). 7p. (CONF-60-4)

From Wescon Institute of Electrical and Electronics Engineers Conference, San Francisco, Aug. 1963.

A generator is shown that was used to observe both the harmonic output and the parametric oscillations of a spherical r-f discharge. A mercury vapor discharge was formed in a pyrex sphere, with an oil bath serving to control the temperature and, thus, the vapor pressure of the mercury. An input signal of 2.85 kMc was coupled to the discharge by means of the input waveguide; the second harmonic was coupled from the discharge by means of the second harmonic choke in the coaxial line, a sliding short, and slide-screw tuner in the harmonic waveguide. A conversion efficiency of 25 per cent to the second harmonic was obtained with an input power of 4.0 watts. A separate uhf coaxial section was used to conduct low frequency experiments, to couple to the parametric oscillations, and to improve the stability of the discharge. (R.E.U.)

42149 IMPROVEMENTS IN AND RELATING TO OBTAINING CONTROLLED ATOMIC-NUCLEAR FUSION. Karl Nowak. British Patent 938,987. Oct. 9, 1963. Priority date Dec. 20, 1958, Austria.

A process and apparatus for obtaining controlled nuclear fission are presented. Two beams of light atomic ions are accelerated toward one another and are influenced by magnetic fields such that the ions pass through the magnetic fields with opposite polarities. The two beams, on meeting, have frequencies that are equal or differ very little from one another. The meeting of the beams takes place within an energy receiving device in which the fusion is obtained. (C.E.S.)

42150 GAS CONFINING APPARATUS. Erich S. Weibel (to Space Technology Labs., Inc.). U. S. Patent 3,105,803. Oct. 1, 1963. Filed Jan. 15, 1958.

A toroidal chamber having electrically conducting walls is described for gas-compression and plasma studies. Gas in introduced into the chamber and ionized, and a microwave resonant field is applied to the chamber in such a fashion that electric-field nodes are established inside the torus. A transformer coil is wrapped around the torus in order to provide axial positioning of the plasma in the electric-field nodes. The electromagnetic field of the microwave cavity compresses the ionized gas into the central region of the toroidal chamber. (T.F.H.)

42151 GAS DISCHARGE APPARATUS. Peter Clive Thonemann (to United Kingdom Atomic Energy Authority). U. S. Patent 3,105,806. Oct. 1, 1963. Priority date Oct. 15, 1957, Great Britain.

A toroidal pulsed discharge chamber is described that contains a high-resistivity corrugated toroidal liner. On the outside of the liner, and within the grooves formed by the corrugations, are situated Cu current-carrying rings. Thus when a disruptive axial magnetic field between the

liner and the chamber wall begins to penetrate into the volume enclosed by the liner, the changing magnetic field sets up a current in the Cu rings, and this current in turn produces a magnetic field that tends to oppose the original magnetic field. The Cu rings thus reduce the leakage of any external axial magnetic fields into the discharge chamber. (T.F.H.)

42152 NUCLEAR APPARATUS. George E. Mallinckrodt. U. S. Patent 3,107,210. Oct. 15, 1963. Filed June 26, 1959.

Equipment is described for subjecting small cylindrical needles of lithium hydride to a cylindrically imploding shock wave produced by application of current to a cylindrical conductive jacket that is concentric around the needles. The current is large enough to vaporize the needles at once producing a shock wave of cylindrical geometry that implodes through the needles. The temperature is raised sufficiently to induce the nuclear reactions. (C.E.S.)

42153 NUCLEAR APPARATUS. George E. Mallinckrodt. U. S. Patent 3,107,211. Oct. 15, 1963. Filed Jan. 25, 1960.

Apparatus is described for inducing nuclear reactions in which a constrictive effect of a magnetic field is employed for improved operation. Electric conductors form helices looped around a substantially common straight-line axis. The helices are symmetrically positioned with respect to one another both axially and peripherally with respect to the axis. A fuel assembly extends along the axis with the helices. The fuel assembly includes a core selected from isotopes of hydrogen and lithium hydride enclosed in a conductive jacket. A condenser is discharged through the conductors and conductive jacket with a current sufficient to vaporize both the jacket and conductors whereby the temperature of the core is raised sufficiently to induce a nuclear reaction. (M.C.G.)

Shielding

Refer also to abstract 41116.

42154 (PWAC-397) GEOMETRICAL ATTENUATION FACTORS FOR GAMMA RADIATION FROM CYLINDRICAL AND SPHERICAL SURFACE SOURCES. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Sept. 15, 1963. Contract AT(30-1)-2789. 32p.

A method for deriving geometrical attenuation factors of distributed surface sources is formulated, and factors are presented in the form of curves for cylindrical and concave spherical geometries. The factors are plotted versus the ratio of the detector-source separation to the radius of the source. A wide range of cylinder sizes is covered by a family of curves with ratios of length-to-radius ranging from 0.5 to infinity. Curves are presented for concave spherical surfaces of various polar angles, between 10 and 90 degrees. The detector-source separation distance ranges from 0.5 to 100 cylinder radii for the cylindrical geometry, and from 0.1 to 10.0 radii for the concave spherical geometry. Beyond these detector distances, the analytical expressions representing the geometrical attenuation are approximated by simpler asymptotic forms in which the cylindrical and spherical sources can be effectively treated as line and point sources, respectively. Sample flux calculations are presented for both geometries. (auth)

42155 (AEC-tr-6056) STUDIES OF MOCK-UPS. URANIUM, STAINLESS STEEL, WATER. P. Pepin, C. Goulet, and J. Riggenbach (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses). Translated for Oak Ridge National Lab., Tenn., from report DEP/SEPP/197/62. Jan. 1962. 7p.

The following two mockups were studied: (1) 20 cm U + 50 cm H_2O + 50 cm stainless steel, with thermal and epithermal flux in H_2O behind the 20 cm U; and (2) 20 cm U + 50 cm stainless steel + 50 cm H_2O, with thermal and epithermal flux in H_2O behind 20 cm U + 50 cm stainless steel. Thermal and epithermal flux measurements from bare Mn and Mn/Cd detectors are reported for various distances in H_2O. The neutron currents leaving the scattering medium are calculated. Attenuations of 15.4 and 45 were obtained by passing through 20 cm U and 50 cm Fe behind 20 cm U, respectively. (D.L.C.)

42156 (AEC-tr-6093) EXPERIMENTAL STUDY OF SHIELDING. P. Pepin, J. Rastoin, and Sivagnanam (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Translated for Oak Ridge National Lab., Tenn., from report DEP/SEPP-153/61. [1961]. 36p.

The Naiade I and II systems of the Triton reactor, which were used in shielding experiments for various reactor types, are described. The instruments developed for the experiments are also described. The calculation of fast neutron doses and thermal flux is considered, and the constants for use in the two-group diffusion theory for determining the thermal flux are given. Some mock-up results are plotted. (D.L.C.)

42157 NOMOGRAMS FOR THE CALCULATION OF AQUEOUS SHIELDS FOR NEUTRONS ORIGINATING FROM (α,n) SOURCES. E. A. Kramer-Ageev and V. P. Mashkovich. At. Energy. (USSR), 15: 160-1(Aug. 1963). (In Russian)

Water and paraffin are the most commonly used neutron shielding materials for the (α,n) type sources. In order to facilitate the calculations, nomograms were constructed from which the data needed for the design of water shields can be obtained very conveniently. The nomograms correlate the radiation rate S (n/sec) of the isotropic point source, the distance R (cm) from the source to the operating area, and the thickness d (cm) of the water shield. An operational period of 6 hours per day and a maximum permissible occupational exposure of 0.1 rem per week were used as basis of the construction of the nomograms; other conditions may be substituted by making suitable corrections in the graphs. The field of the nomogram lying to the right of the zero thickness (d = 0) line indicates the safe operating conditions. The region in which greater shielding is needed than the distance provided, is indicated by shading. Examples are given for Po–Be sources. It is emphasized that the requirements for complete γ shielding must be calculated separately. (TTT)

42158 ATTENUATION OF RADIATION FROM DISTRIBUTED GAMMA SOURCES AS A FUNCTION OF WALL THICKNESS OF A CONCRETE BLOCKHOUSE. M. A. Schmoke, R. E. Rexroad, and H. J. Tiller. 16p. (CONF-39-97)

From American Nuclear Society 9th Annual Meeting, Salt Lake City, June 1963.

The experiment described constitutes part of the shielding program conducted by Army Nuclear Defense Laboratory and was designed to experimentally verify theoretical calculations used to predict the amount of radiation protection afforded by above-ground structures in a fallout radiation field. This method requires the knowledge of

some physical parameters of a structure such as mass thickness of the walls and the geometric orientation of the detectors within the structure. From this information, a reduction factor for any given structure may be calculated. This Laboratory's experimental program was initially begun by measuring the attenuation of a simple structure with no complicating internal or external geometries and will proceed to more complex structures with basements, interior partitions, and upper floors. (auth)

Theoretical Physics

42159 (LNF-62/105) EQUATIONS OF MOTION OF SPINNING PARTICLES IN THE TETRAD THEORY OF GRAVITATION. Note No. 172. C. Pellegrini (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali di Frascati). Dec. 10, 1962. 8p.

The equations of motion of spinning particles are derived from the generalized Bianchi identities obtained by Pellegrini and Plebanski in the framework of the tetrad theory of gravitational fields. (auth)

42160 ON THE FUNCTIONAL FORMALISM OF THE S-MATRIX. Jan T. Lopuszanski (Univ. of Wroclaw, Poland and Inst. of Physics, Polish Academy of Sciences, Wroclaw). Acta Phys. Polon., 24: 23-9(1963). (In English)

A method of obtaining the S-matrix in form of an expansion in terms of the free incoming field is presented. This method differs slightly from the usual approach: an auxiliary c-number field Φ instead of the auxiliary c-number current J is used. The exponent of the generating functional is closely related to the traditional interaction Lagrangian. This procedure leads to vacuum expectation values of the T-products expressed rather in terms of the current j than in terms of the field A. The renormalization problem is clearly exhibited. (auth)

42161 SPIN CONNECTION IN GENERAL RELATIVITY. Hendricus G. Loos (Giannini Scientific Corp., Santa Ana, Calif.). Ann. Phys. (N.Y.), 25: 91-108(Oct. 1963).

The spin connection in the Riemann space of general relativity defines equivalence of two spinors at infinitesimally neighboring events, and evidently carries information about the environment of charged test particles of the fermion type. The spin connection in the four-dimensional space of events is considered as fundamental, and its concomitants and the consequences of its existence are studied. It is found that, if the spin connection permits the existence of a field of Dirac operators γ_k and as associated Riemann geometry, it leaves the γ_k undetermined by a family of continuous transformations generated by γ^5 with a uniform magnitude. If the physics of fermions could be expressed solely in terms of the spin connection, the mean values of all observables would have to be invariant under this family of transformations, and the two-component fermion description proposed by Feynman, Gell-Mann, Sudarshan, and Marshak would follow. Another indeterminancy of the γ_k, for a fixed spin connection, consists of a family of scale transformations of uniform magnitude over the whole space of events. The transformations of this family are of no physical consequence, as they can be compensated by a uniform change in proper time scale. For a fixed spin connection, there are usually no other indeterminacies of the γ_k of the continuous kind. The existence of the spin connection implies a conservation law for a spin tensor density derived from the Dirac operators and the spin curvature tensor, whose trace is the Einstein tensor density. (auth)

42162 CORRELATION FUNCTIONS OF CLASSICAL GASES. David Ruelle (Inst. for Advanced Study, Princeton, N. J.). Ann. Phys. (N. Y.), 25: 109-20(Oct. 1963).

The limit of an infinite system is investigated for the correlation functions of a classical system of particles with two-body central interaction. Analyticity properties in the activity are proved, which imply the existence of a gas phase and the convergence of the virial expansion. (auth)

42163 GREEN'S FUNCTION DERIVATION OF THE METHOD OF APPROXIMATE SECOND QUANTIZATION. Donald H. Kobe (Ohio State Univ., Columbus). Ann. Phys. (N. Y.), 25: 121-131(Oct. 1963).

Plasma Alfvèn waves propagating in certain inhomogeneous magnetic fields suffer a strong anomalous viscous and Ohmic dissipation. The dissipation is caused by transversal velocity differences of the wave resulting from the different propagation velocities along the lines of force. The effect may be useful for heating a plasma of high temperatures and may become competitive with the gyrorelaxation effect. The predicted rapid dissipation may also be of significance in astrophysical questions. The dissipation is studied for a simple inhomogeneous magnetic field. The results, however, can be semiquantitatively extended o less simple inhomogeneous fields. It is shown that the homogeneous magnetic field belongs to a wider class of magnetic fields which do not lead to anomalous dissipation of Alfvèn waves. It is also shown that magnetic fields possessing this property have to satisfy a certain nonlinear partial differential equation. The anomalous dissipation is studied for a special model in further detail. It is shown that the described anomalous dissipation is connected with the existence of a peculiar transversal wave which is strongly damped and which is propagating in a direction perpendicular to the lines of force. (auth)

42164 AN EXACTLY SOLUBLE TWO-BODY PROBLEM WITH NON-CENTRAL FORCES. B. Davies and L. M. Delves (Univ. of New South Wales, Kensington, Australia). Australian J. Phys., 16: 311-13(Sept. 1963).

A class of local potentials is given that includes hard cores and a finite-range central, tensor, and LS part, and for which the lowest two neutron-proton states ($J = 0$, $\pi = +1$ and $J = 1$, $\pi = +1$) are exactly soluble. A numerical example is given in which the form factor for the potentials is a hard core plus square well. (auth)

42165 EIGENFUNCTIONS OF THE f^3 CONFIGURATION. J. C. Eisenstein. J. Res. Natl. Bur. Std., 67B: 169-80(July-Sept. 1963).

Wave functions for three equivalent f electrons that are eigenfunctions of L^2, S^2, J^2, and J_z are given. The eigenfunctions are given in tabular form. (R.E.U.)

42166 CLUSTER EXPANSION OF OPERATOR AVERAGES FOR SYSTEMS OF MANY PARTICLES. J. Da Providencia (Universidade, Coimbra, Portugal). Nucl. Phys., 46: 401-12(Aug. 1963). (In English)

A systematic method enabling operator averages of many-body systems to be expanded in terms of cluster integrals was developed. The cluster integrals may be conveniently defined with the help of a diagram technique analogous to the one used in perturbation theory. The method proposed is suitable for applying both the time independent and the time dependent variational principles to many-particle systems involving singular interactions. The Pauli principle is naturally incorporated into the definition of the cluster integrals and this may lead to a rapid convergence of the expansions. The expressions ob-

tained are, as in the Hartree-Fock case, invariant under unitary transformations in the subspaces of the occupied and of the unoccupied single particle states. (auth)

42167 CAUSALITY AND ANALYTICITY IN NON-RELATIVISTIC SCATTERING. J. J. Giambiagi (Universidad, Buenos Aires) and I. Saavedra. Nucl. Phys., 46: 413-16(Aug. 1963). (In English)

The connection between the analytic properties of the scattering matrix and the requirement of causality in non-relativistic potential scattering is discussed using a causality condition formulated by Schützer and Tiomno. (auth)

42168 UNITARITY AND THE EVALUATION OF DISCONTINUITIES. PART II. D. I. Olive (Cambridge Univ., Eng.). Nuovo Cimento (10), 29: 326-35(July 16, 1963).

The discontinuity across the cut due to the normal threshold N in the scattering amplitude is found to be a modification of the term in unitarity involving the state N. The result shows that it is easiest to continue onto the unphysical sheet reached by encircling the normal threshold in an anticlockwise direction and enables unitarity to be replaced by a system of simpler equations. The result is understood in perturbation theory and is presented in terms of a specially introduced path notation for unphysical sheets. Although the argument is mainly restricted to two-particle thresholds, it permits the analytic continuation round the lowest three-particle cut. The difficulties in extending the analysis to multiparticle processes are reviewed. (auth)

42169 THE TOTAL ANGULAR-MOMENTUM PLANE IN THE NONRELATIVISTIC THREE-BODY PROBLEM. R. G. Newton (Università, Rome). Nuovo Cimento (10), 29: 400-19(July 16, 1963).

The Regge method is extended to the nonrelativistic three-body problem. The usual many-channel procedure is extended to treat the case of a particle impinging upon a bound state of two others, fully taking into account the possibility of three free particles emerging. The total angular momentum quantum number j along with one of the orbital momenta l_1, is continued into the complex plane, the other orbital momentum l_2 and the difference $j-l_1$ being kept integral. Three kinds of branch points of the square root type are found. The first are kinematic, fixed at the integers; they prevent the S-matrix from being unitary, except at integral values of j, but cancel in the amplitudes. The second are also generally fixed at the integers. The third are energy dependent. Each two-particle Regge pole trajectory manifests itself in the three-particle S-matrix as an infinite number of branch-point trajectories. The argument that leads to them is easily generalized to the case of n particles. (auth)

42170 LEVINSON'S THEOREM AND REGGE POLES. M. Ciafaloni (Scuola Normale Superiore, Pisa, Italy and Seuola di Perfezionamento in Fisica Nucleare, Pisa, Italy). Nuovo Cimento (10), 29: 420-7(July 16, 1963).

Some properties of Regge poles are discussed in the light of Levinson's theorem. Under certain hypotheses on the potential, an alternative proof of this theorem is given. (auth)

42171 STUDY OF THE NUMBER OF PARTICLES IN THE QUASI-PARTICLE APPROXIMATION. J. Hoegaasen Feldman (Faculte des Sciences, Orsay, France). Nuovo Cimento (10), 29: 428-40(July 16, 1963). (In French)

The distribution, with respect to the number of particles, of the functions describing, in the quasi-particle approximation, the ground state and the first excited levels of systems with an even number of particles is discussed. It can be shown, in concrete cases, the possibility of shifting the spurious state arising from nonconservation of the number of particles in the approximation. (auth)

42172 GAUGE TRANSFORMATIONS IN QUANTUM FIELD THEORY. J. Lukierski (New York Univ., New York). Nuovo Cimento (10), 29: 561-4(July 16, 1963).

Fields are discussed that are described by Lagrangians invariant with respect to gauge transformations. A formula is given that allows the description of quantum gauge transformations in compact form. (R.E.U.)

42173 POSSIBILITY OF GIVING A FINITE MASS TO THE GAUGE FIELD. O. Hara (Nihon Univ., Tokyo). Nuovo Cimento (10), 29: 565-7(July 16, 1963).

The finite mass of particles associated to gauge field theories of strong interactions is shown to appear naturally as the self-energy effect. (R.E.U.)

42174 THE ANALYTIC PROPERTIES OF THE SCATTERING AMPLITUDE IN NONRELATIVISTIC QUANTUM MECHANICS. W. W. Bell (Tait Inst. of Mathematical Physics, Edinburg). Nuovo Cimento (10), 29: 644-54 (Aug. 1, 1963).

The analytic properties of the scattering amplitude in potential theory are investigated using an iterative momentum-space method involving both the Lippmann-Schwinger and the Low equations. The usual cuts in the energy and momentum transfer are obtained together with the bound-state poles. (auth)

42175 SINGULARITIES OF FEYNMAN AMPLITUDES. I. T. Drummond (Cambridge Univ., Eng.). Nuovo Cimento (10), 29: 720-41(Aug. 1, 1963).

The analytic properties of perturbation theory amplitudes written as integrals over internal invariants are discussed. Single-loop amplitudes are considered and a condition, equivalent to the positive α condition, is derived for singularity in the physical limit. Some simple double-loop diagrams are discussed also and the existence and nature of a certain mixed second-type singularity is investigated. A feature of these latter diagrams is the necessity of dealing with spurious singularities. The relevance of these considerations to certain three-particle phase-space integrals is pointed out. (auth)

42176 STRUCTURE OF FIELD QUANTITIES AND S-OPERATOR. A. Visconti and J. Carmona (Faculté de Sciences, Marseille). Nuovo Cimento (10), 29: 742-59 (Aug. 1, 1963).

Functional techniques are used to obtain fundamental concepts in quantum field theory. The case of a scalar hermitian field is considered. The mapping operator, S-operator, unitarity conditions, the dynamical constraint imposed on a free field, and the action integral are discussed. Haag's equation and Wick's theorem are derived. (C.E.S.)

42177 INVARIANCE HYPOTHESIS AND HAMILTONIAN MATRIX ELEMENT CORRELATIONS. Nazakat Ullah and Ch. E. Porter (Brookhaven National Lab., Upton, N. Y.). Phys. Letters, 6: 301-2(Sept. 15, 1963). (BNL-7216) (In English)

The correlations of the Hamiltonian matrix elements are presented to the extent that they are determined by the invariance hypothesis only. It is shown that the invariance hypothesis leads to the conclusion that there are no correlations between the diagonal and off-diagonal matrix elements but that the diagonal elements may be correlated for some eigenvalue distribution. (R.E.U.)

42178 GROUP THEORY AND MANY-BODY PROBLEMS WITH FINITE NUMBER OF STATES. M. Moshinsky (Uni-

versidad de Mexico, Mexico City). Phys. Letters, 6: 305-6(Sept. 15, 1963). (In English)

It is shown that an important class of many-body problems can be solved with the help of group theoretical ideas similar in structure to those underlying a technique for solving the problem of the asymmetric top. Only those problems are considered which have a finite number of single-particle states. (R.E.U.)

42179 RELATIVISTIC COULOMB-LIKE GREEN'S FUNCTIONS IN CLOSED FORM. N. V. V. J. Swam and L. C. Biedenharn (Duke Univ., Durham, N. C.). Phys. Letters, 6: 315(Oct. 1, 1963).

It is pointed out that an improvement can be made over approximate solutions of Coulomb Green's functions. The relativistic Green's function is obtained to an exact factorization of the iterated Dirac-Coulomb Hamiltonian with the single term $(\alpha Z/r)^2$ removed. (R.E.U.)

42180 QUANTIZED GRAVITATIONAL FIELD. [PART] II. Julian Schwinger (Institut des Hautes Etudes Scientifiques, France). Phys. Rev., 132: 1317-21(Nov. 1, 1963).

A consistent formulation is given for the quantized gravitational field in interaction with integer spin fields. Lorentz transformation equivalence within a class of physically distinguished coordinate systems is verified. (auth)

42181 THEORY OF SYMMETRY PROJECTIONS IN APPLIED QUANTUM MECHANICS. Stig Flodmark (Univ. of Stockholm). Phys. Rev., 132: 1343-8(Nov. 1, 1963).

The Wigner projection operator used in group theory for finding symmetry-adapted states in quantum mechanics is represented as a matrix in a given basis of trial state vectors. By diagonalizing this projection matrix, the redundancies occurring when the projection operator is applied directly are removed automatically. A straightforward method is given for this diagonalization procedure using only general properties of projection matrices. This method has proved very powerful in numerical applications using electronic computers. Particularly for the ligand-field treatment of a part of a crystal or in the case of a molecule of general point-group symmetry, the projection matrix to be used in the MO-LCAO method is constructed and simplified. This is done also for the nonsymmorphic space groups of crystals in the tight-binding approximation of band theory. The whole procedure of constructing symmetry-adapted states in this case was programmed for an electronic computer. (auth)

42182 A NOTE ON REGGE TRAJECTORY IN $\lambda\varphi^4$ THEORY. P. Y. Pac (Univ. of Illinois, Urbana). Progr. Theoret. Phys. (Kyoto), 30: 201-6(Aug. 1963).

A leading Regge trajectory of the Bethe-Salpeter scattering amplitude is investigated in the ladder approximation, under the introduction of a spectral function for the dispersion relation for an infinite sum of chain diagrams. (auth)

42183 RELATIVISTIC HAMILTONIAN FORMALISM IN QUANTUM FIELD THEORY AND MICRO-NONCAUSALITY. Hiroshi Enatsu (Ritsumeikan Univ., Kyoto). Progr. Theoret. Phys. (Kyoto), 30: 236-64(Aug. 1963).

An attempt is made to extend the Heisenberg-Pauli theory of quantized fields in a relativistically invariant way. The transformation theory of Dirac is used as a basis for that purpose. It is assumed that a mass variable is canonically conjugate to an invariant-time variable, being a common time to all fields. Considering that the field functions in the usual quantum field theory are those expressed in terms of a mass representation, the field functions are transformed into those in an invariant-time representation. It is shown that in the new representation a relativistic Hamiltonian formalism of quantum field theory can be obtained and the configuration space method in nonrelativistic case can be generalized. The new formalism is applied to the bound state problem. It is shown that, for the interactions between two particles in bound states, the condition of micro-noncausality plays an important role. As simple examples, the bound states of deuteron-like and hydrogen-like systems are discussed. For simplicity the new formalism is developed for charged spin zero fields, but the extension to other cases is obvious. (auth)

42184 ON THE FORWARD PEAK OF SCATTERING IN THE HIGH ENERGY LIMIT. Seiya Aramaki (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 30: 265-6(Aug. 1963).

It is shown, assuming the Mandelstam representation and using low-energy experimental data, that the forward peak appears in the scattering amplitude in the high-energy limit though a possible occurrence of the backward cannot be excluded. (R.E.U.)

42185 GROUP THEORY AND THE MANY BODY PROBLEM. Marcos Moshinsky (Universidad de Mexico, Mexico City). 34p. (CONF-13-8)

From American Physical Society 1963 Southwestern Meeting, Houston, Tex., Feb. 1963.

Group theoretical techniques are pointed out which are effective for dealing with some many body problems. While Group Theory provides the backbone of all of the following discussion, very little of its abstract formalism is used. The part used is either discussed in the text or the results for the group under discussion are stated pointing out the analogy between these results and those of the familiar rotation group. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 41727, 41729, and 41731.

42186 (AEEW-R-241) A STUDY OF NON-INTERACTING CONTROL FOR NUCLEAR REACTORS. J. D. Cummins (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). July 1963. 32p.

A specific example of non-interacting control for a reactor is considered. The study examines the behavior of a linearized transfer function model of the BEPO reactor at full power and full flow. A theoretical controller is postulated in which flow controls neutron power and control rod position controls fuel temperature. The conditions for this controller to be non-interacting are developed and the theoretical controller determined. The transient responses for each controller to step changes in the demand signals are determined. The approximate controller shows a need for further work if the cross-coupled terms in the controlled system are to be sufficiently attenuated. The direction which future investigation might take is discussed. Where speed of response to demand changes is a primary requirement, such as in a propulsion unit, non-interacting control offers advantages over conventional automatic control schemes. (auth)

42187 (DPST-63-69-9) EFFECT OF ROD SPACING ON HEAT TRANSFER BURNOUT. USAEC-AECL Cooperative Program Quarterly Progress Report, June–August 1963. R. H. Towell (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1963. Contract AT(07-2)-1. 8p.

At the end of the third quarter, the work on the surrounding-rod mockup, which is being fabricated at SRL, was about 90% complete. The mockup is expected to be ready for testing about the first week of October 1963. Preliminary shakedown tests were made with the annular housing tube in place of the surrounding-rod mockup. The tests indicated required changes to prevent failure of the sapphire spacer pins and to minimize bowing of the central rod. (auth)

42188 (GA-4612) THE USE OF BeO IN ADVANCED REACTOR CONCEPTS. A. J. Goodjohn and H. B. Stewart (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Oct. 15, 1963. Contract AT(04-33)-187. 24p. (CONF-281-3)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Some technical advantages that are displayed by beryllium-oxide-reactor concepts and the development and experiments that are required and planned to proof-test fuel modules typical of those used in such reactors are described. The possible use of beryllium oxide as the moderator in gas-cooled reactors with either uranium or plutonium as the fissile material and thorium as the fertile material is discussed. The characteristics of the Experimental Beryllium Oxide Reactor are summarized. (M.C.G.)

42189 (GEMP-79) REACTOR INSTRUMENTATION AND CONTROL PROGRESS REPORT NO. 79. (General Electric Co. Flight Propulsion Lab. Dept., Idaho Falls, Idaho). Sept. 30, 1963. Contract AT(40-1)-2847. 25p.

Testing of beryllia and thoria dielectric specimens for the probe-type temperature sensors at 3000 to 4000°F was continued. The 2800°F integrated probe and readout system refinements were continued. Testing of fission counters and fission counter components to 1500°F, and d-c ionization chamber components to 1200°F was continued. A split collector was made and tested at 1000°F. Two cylindrical gridded a-c ionization chambers and four charged-fragment detectors were tested under x-ray and thermal neutron flux. Operation of a compensated a-c ionization chamber was investigated. Construction of three charged-fragment neutron detectors with an alpha-particle absorber applied over the boron-10-coated electrode was continued. (N.W.R.)

42190 (IA-820) CALIBRATION OF CONTROL RODS USING THE ROD DROP METHOD. W. Rothenstein (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth). June 1963. 18p.

The validity of an approximate formula used for computation of the flux decay in terms of reactivity, when a control rod is suddenly dropped into a reactor is discussed. It is shown that in many cases more accurate calculations must be made. An iterative procedure for calculating the decay of the flux, is described and developed to the point where it can be programmed for a digital computer. A machine programme based on this method is described. Tables, based on six groups of delayed neutrons, are given, that permit determination of the reactivity of the control rod from the behavior of the flux after the rod drop. (auth)

42191 (IDO-11223) FINAL PROGRESS REPORT ON ORGANIC COOLANT TECHNOLOGY—FILM FORMATION STUDIES, NOVEMBER 1962–APRIL 1963. J. F. Black, P. R. Geissler, and J. Mackinnon (Esso Research and Engineering Co. Products Research Div., Linden, N. J.). May 31, 1963. Contract AT(10-1)-1124. 26p.

Experiments with various fractions from tritium-labelled OMRE used coolant show that the oxygen-rich fractions contribute heavily to film formation in the Pyrolytic Capsule Fouling Test (PCFT). These fractions were not necessarily particulate matter or iron laden. Similar experiments were run using fractions of a carbon-14-labelled used coolant which was prepared by the extended irradiation of carbon-14 labelled terphenyls. Intermittent purification was used to keep high boilers below 30%. These materials were prepared in the absence of oxygen in quartz containers. None of the fractions formed under these conditions showed any marked tendency to form films in the PCFT. (auth)

42192 (IEA-54) DETERMINACAO DO λ_{TR} DE MEIOS MODERADORES PELO METODO DE FONTE PULSADA. (Determination of λ_{TR} of Intermediate Moderators by the Pulsed Source Method). H. R. Franzen (Brazil. Instituto de Energia Atomica, Sao Paulo). Sept. 1962. 17p.

A method for the determination of the mean free transport path of intermediate moderators is developed, based essentially on obtaining the decay constants (λ) for two different moderator heights. Prismatic and cylindrical geometries and the mean free path of neutrons injected from a pulsed source are considered for two different moderator heights. The value of the mean free transport path is obtained by the solution of the equation

$$2.84\left[\frac{(c_1+c_2)^2}{c_1c_2}-1\right]\lambda_{TR}^2-(c_1+c_2)\,\lambda_{TR}+\frac{3(\lambda_2-\lambda_1)}{\bar{v}^2}\,\frac{(c_1c_2)^2}{(c_1-c_2)}\simeq$$

O(A), where c_1 and c_2 are two different moderator heights. (tr-auth)

42193 (NAA-SR-5201) THERMOPHYSICAL PROPERTIES OF IRRADIATED POLYPHENYL COOLANTS. PART III. THERMAL CONDUCTIVITY. G. Asanovich, R. S. Moore, and K. Koda (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 15, 1963. Contract AT(11-1)-Gen-8. 28p.

The thermal conductivities of the polyphenyl mixtures used as organic coolant in the Organic Moderated Reactor Experiment (OMRE) were determined over the temperature range of 300 to 650°F. The thermal conductivities were found to decrease linearly with increasing temperatures: values for the unirradiated coolant were 0.080 and 0.071 Btu/hr-ft-°F at 300 and 650°F, respectively. The thermal conductivity of the irradiated coolant containing 30 wt % high boiler decomposition products was approximately 8% higher than that of the unirradiated coolant over the same temperature range. (auth)

42194 (NP-13162) ALGOL PROGRAMS NE-1 AND NE-2 FOR REACTIVITY STEP CALCULATIONS. Technical Report No. NE-1, Nuclear Engineering Series. W. W. Graham, III and D. S. Harmer (Georgia Inst. of Tech., Atlanta. School of Nuclear Engineering). Aug. 1963. 47p.

The programs NE-1 and NE-2 for calculating the time-dependent behavior of a reactor after a step change in reactivity using one-group, space-independent zero-power kinetic theory are described. NE-1 assumes all delayed neutron precursors to be in equilibrium at the time of a step change, while NE-2 accounts for non-equilibrium. NE-1 and NE-2 are ALGOL translations of RE-126 and RE-135 in FORTRAN for the IBM-704. Program listings, a sample problem, sample input and output, and some main equations are included. (D.C.W.)

42195 (STL-6212) KINETIC STUDIES OF HETEROGENEOUS WATER REACTORS. Annual Summary Report, 1962. (Space Technology Labs., Inc., Redondo Beach, Calif.). Dec. 30, 1962. Contract AT(04-3)-372. 33p.

The dominant cause of hydrodynamic instabilities in natural circulation boiling water reactors was found to be unstable linear feedback between flow and steam void volume. The power-void transfer function is also dominated by this flow-void feedback, so both the reactivity feedback type of boiling water reactor instability and the power oscillations arising from hydrodynamic instability have the same cause. The parallel channel interaction in a natural circulation boiling water reactor is such as to allow two modes of hydrodynamic oscillation to exist; one is identical to the single-channel hydrodynamic oscillations observed in the laboratory, while the second is identical to the multi-channel instability which occurs in forced-flow systems. Both modes of multi-channel instability are predictable from laboratory measurements on a single channel. A method of estimating the steady-state steam-void fraction in a boiling water reactor channel was developed utilizing the principle of minimum entropy production. An analysis of possible causes of severe pressure pulses in heterogeneous reactor transients produced a hypothesis that such pulses could be caused by the very rapid thermal expansion (single phase) of a conductively heated thin film of liquid as the fuel surface temperature passes through the thermodynamic critical temperature. This hypothesis was evaluated analytically, and it was found that a mechanism can cause a very severe pressure transient if a sufficiently large ratio of heated surface to core volume exists, and if the reactor period is short enough. However, the results of applying this analysis to the destructive transient in the BORAX I reactor show that several times the actual surface area ratio would have been required in order for a supercritical pressure pulse to have been caused by this mechanism. This result is dependent on the equation of state used for the superheated liquid film. (auth)

42196 (TID-11892(Del.)) NATURAL CONVECTION IN-PILE LOOP. J. K. Sparrell (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Dec. 27, 1957. Contract [AT(11-1)-229]. 27p.

A small, natural-convection, NaK-cooled in-pile loop is described. The loop has a 3-in. diameter and is 7-ft long. The loop is designed for testing small fuel pins at high-power densities. Temperature control in the loop is achieved by controlling the coolant flow rate. (T.F.H.)

42197 (TRG-Report-617) REST. A REACTOR TRANSIENT PROGRAM FOR THE I.B.M. 7090. C. W. J. McCallien (United Kingdom Atomic Energy Authority. Reactor Group, Risley, Lancs, England). Aug. 19, 1963. 36p.

The one-group, three-dimensional reactor transient program STAB was modified. The new version, REST, which can be used in the theoretical study of transients in thermal reactors with re-entrant coolant systems is described. The new heat transfer equations are presented, along with an account of the numerical method of solution. The other principal equations are also presented. Data requirements and operating instructions are included. (auth)

42198 (AEC-tr-6091) CALCULATION AND MEASUREMENT OF HEAT LIBERATED BY RADIATION IN INSTALLED NON-FISSILE MATERIALS. E. Kmiotek and G. Manent (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Translated for Oak Ridge National Lab., Tenn., from report DEP/SEPP-166/61. June 1961. 15p.

Calculations revealed that in lead and tin, heating by thermal neutron capture and radioactive decay is negligible compared to the heating due to the absorption of gamma rays from the reactor. The heat liberated in lead and tin cylinders was measured by calorimeters. The values obtained agree well with calculations for the gamma heating. (D.C.W.)

42199 (EURAEC-777) EFFECTIVE CROSS SECTION CALCULATION AND NEUTRON THERMALIZATION. Special Report S 8. R. Naudet (France. Commissariat à l'Énergie Atomique, Paris). 1963. Work Performed under United States–Euratom Joint Research and Development Poogram. 48p. (A translation)

The results of studies on problems connected with thermal reactor spectra are presented. Representation of thermalization for effective cross section calculations is the particular concern. Both heterogeneous and homogeneous media are considered. (D.C.W.)

42200 (EURAEC-778) SIMPLE THERMALIZER MODELS. Special Report S 9, November–December 1962. M. Cadilhac (France. Commissariat à l'Énergie Atomique, Paris). 1963. Work Performed under United States–Euratom Joint Research and Development Program. 42p. (A translation)

Simple models used for the representation of real thermalizers are theoretically analyzed. Two types of thermalizers generalized are: primary, depending on an arbitrary function, e.g., heavy gas thermalizer; and secondary, depending on two arbitrary functions, e.g., monoatomic hydrogen gas thermalizer. The perfect thermalizers

are particular cases of secondary thermalizers that can be used in certain cases (interpretation of pulsed neutron experiments). In practice it is indispensable to obtain the accurate flux corresponding to an infinite source of energy and to a low absorption according to the law in 1/v (resonances). This means respecting the function E(y) which represents the principal part in absorption of the deflection of the flux in relation to the Maxwell flux. A primary model may suffice to account for E(y). But if it is desired to consider also rather high absorptions, or absorptions which deviate from the law in 1/v, a secondary model becomes necessary (and this might even, in extreme cases, prove to be insufficient). As to the perfect thermalizer model, this may be used for interpreting phenomena concerning the thermal domain, but its behavior at high energy level is unacceptable. (N.W.R.)

42201 THE THEORY OF HETEROGENEOUS REACTORS WITH FINITE-RADIUS BLOCKS. A. D. Galanin and B. P. Kochurov. At. Energ. (USSR), 15: 107-15(Aug. 1963). (In Russian)

A theory of thermal neutron reactors, possessing cells with dimensions much larger than the neutron scattering path in the moderator, is presented. In contrast to the original Feinberg–Galanin theory, each of the cylindrical blocks is not only a neutron sink but possesses also a dipole moment. For this reason, two polarization constants, which determine the diffusion length in the lattice in parallel and perpendicular directions with respect to the axis, must be defined in addition to the thermal constants. The characteristic lattice equations and formulas for the determination of the diffusion length were derived for the case of sufficiently low absorption in the moderator and a large number of cells in the reactor. As an example, the polarization constants in the P_2 approximation were computed. In the P_1 approximation the results obtained agree well with the results reported previously (Atomnaya Energ. 9, 89 (1960), with the exception of small correction members which were incorrectly calculated in the earlier publication. (TTT)

42202 DENSITY CHANGES OF A BOILING, BULK-HEATED LIQUID IN CASE OF POWER PULSES. V. K. Zavoiskii. At. Energ. (USSR), 15: 164-5(Aug. 1963). (In Russian)

Determination of the mechanism involved in the density changes of a boiling, bulk-heated liquid, caused by a sudden increase of the heat generation, is of great importance for the design of boiling homogeneous reactors. This problem was studied previously, using a γ absorption method for the determination of the density. The density change was ascribed to the formation of bubbles in the liquid. From the review of the literature it was concluded that there is no basis to expect a marked delay in the steam generation under steady-state conditions, if the growth of the bubbles is taken into consideration. Earlier workers (R. Lipkis et al. Chem Engng. Progr. Symposium Series 52: 105 (1951); M. Greenfield et al. Report 54-77, Dept. of Engineering, UCLA) also found that the initial rate of change of the density in a sudden power pulse decreases with increasing pressure. Therefore, in order to determine the density change in the case of a power excursion in a bulk-heated liquid, the growth of bubbles present at the start of the excursion must be taken into account; equations derived for the growth of stationary vapor bubbles cannot be used for calculating a system containing bubbles in motion. (TTT)

42203 CONSIDERATION OF THE SPECIFIC RELEASE OF FISSION PRODUCTS FROM FUEL ELEMENTS. W. M. Pusch. Atomkernenergie, 8: 311-15(Sept. 1963). (In German)

The burnup of fuels in a reactor core causes the escape of certain percentages of fission products accumulated into the atmosphere of the containment. The activities, which would be released in case of a maximum credible accident, are the basic assumptions for all security calculations concerning the external and internal exposure of people in the environment of the reactor plant. Usually only those activities of each isotope (corrected by the radioactive decay) present in the fuels at the moment of the reactor accident are considered. The amount of the different activities rising from decay of parent atoms (in case the isotopes in question are members of a decay chain), is neglected. It is shown that the neglections are admissible, mainly by reason of the low toxicity particularly of those isotopes in which the neglected amount of activity is of high percentage. (auth)

42204 THE ACTIVATION OF WATER IN THE SECONDARY AND AUXILIARY CIRCULATING SYSTEMS OF A REACTOR. A. Schatz (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Atomwirtschaft, 8: 414-18(July-Aug. 1963). (In German)

In almost all reactors there are water circulating systems which although not passing through the fission zone still traverse regions in which there is a relatively high neutron flux. The induced activity is in general weak and essentially smaller than, for example, in the primary circuit of a water-cooled reactor. Although it would be basically feasible to incorporate these secondary and auxiliary circuits in the shielded and controlled areas the large expenditure this would incur is usually not necessary. In many cases it is possible to keep the activity of the water so small that these circuits can be brought outside the screened area and so out of the controlled region. The activity of water in secondary and auxiliary circuits which run in part through neutron fields was calculated. The provisions of the First Radiation Protection Regulation for the German Federal Republic are discussed in detail and the conclusion drawn that the requirements which are placed on the purity of water in respect of the concentration of radioactive isotopes are too great, particularly for short-lived isotopes. (auth)

42205 DESIGN FORMS OF REACTOR CONTAINMENTS. W. Ullrich (AEG, Frankfurt am Main). Atomwirtschaft, 8: 418-23(July-Aug. 1963). (In German)

When utilizing nuclear energy in reactors steps must be taken to prevent the build-up of an inadmissible level of danger to the surroundings through the escape of activity into the atmosphere either during normal operation of the reactor or in the case of the worst conceivable accident. In the analysis of such an accident an investigation was made of the consequences of a breakage in the primary system. From the analysis the requirements were obtained that are to be imposed on the reactor containment in respect of its leak tightness and screening. Economic considerations then lead to one choice from a series of designs which provide the necessary safety for the specific reactor type and for the chosen situation. In the case of a few reactor types it is possible for fission products to escape directly or indirectly into the atmosphere if a breakage occurs in the primary system. To prevent this happening it is necessary to provide a pressure tight reactor containment which encloses the reactor and the primary circulatory system. The lay-out, materials and building form of reactor pressure vessels and their setting-up are described in detail. Eight pressure vessel systems result

from the various installation conditions and arrangements and their construction and examples of their use are discussed. (auth)

42206 THE INSTRUMENTATION SYSTEM OF THE KEMA SUSPENSION TEST REACTOR (KSTR). J. J. van Zolingen. Atoomenergie Haar Toepassingen, 5: 133-41 (July 1963). (In Dutch)

The extensive instrumentation necessary for the KEMA Suspension Test Reactor was described. In addition to the apparatus for normal operating conditions, provisions must be made for very accurate measurements under certain conditions. The instrumentation necessary for incidental measurements were also described. (tr-auth)

42207 ON THE DETERMINATION OF LOW REACTIVITIES WITH THE AID OF STATISTICAL SOURCE FLUCTUATIONS. Maurice Surdin. Compt. Rend., 257: 1274-5(Aug. 5, 1963). (In French)

Two methods are described for determining the reactivity, starting from the statistical fluctuations of the number of neutrons in the subcritical reactor. One of the methods uses the "spectral intensity," and the other uses the number of "passages through zero" of the fluctuations of the number of neutrons per unit time. (tr-auth)

42208 THE STATISTICAL ANALYSIS OF SAFETY FACTORS. Agustin Alonso Santos (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 7: No. 26, 21-6 (Apr.-June 1963). (In Spanish)

The method of errors is compared with the statistical method for the analysis of reactor safety factors. As an example, the temperature in the center of a fuel element with homogeneous burn-up is calculated. (J.S.R.)

42209 THE "SPECTROX" METHOD FOR THERMAL SPECTRA IN LATTICE CELLS. D. C. Leslie (Atomic Energy Establishment, Winfrith, Dorset, Eng.). J. Nucl. Energy, Pts. A & B, 17: 293-306(Sept. 1963). (In English)

The methods normally used in reactor physics calculations either ignore altogether the spatial dependence of the thermal spectrum in a lattice cell or grossly over-simplify it. This approach is not satisfactory for interpreting experiments and it is dubious for design work on reactors containing two moderators at widely differing temperatures such, for example, as the heavy water-moderated light water-cooled SGHW. The most obvious method of studying the spatial variation of thermal spectrum is to use a multigroup transport code with no restrictions on the energy transfer matrix. The Carlson SNG program is suitable for this work and it was used, together with the results that were obtained on various reactor systems. Brief reference is made to the Winfrith DSN program, which is now coming into use as a replacement for SNG. This method is laborious and expensive in machine time and a method known as SPECTROX was developed in parallel with this work. The SPECTROX method is based on a collision probability treatment of the flux in the fuel and it leads to a pair of simultaneous energy-dependent equations, which determine the mean flux in the fuel and in the moderator. Descriptions are given of the theory of this method, the computer programs that were written to exploit it, and some results that were obtained with it. It appears to give adequate accuracy for the thermal spectrum in normal systems. (auth)

42210 FINDING A CORROSION-RESISTANT CLADDING FOR SUPERHEATER FUELS. C. N. Spalaris (General Electric Co., San Jose, Calif.). Nucleonics, 21: No. 9, 41-9(Sept. 1963).

Nuclear superheat can increase BWR power-plant efficiency and reduce nuclear power cost. Superheater fuel elements are exposed to high neutron flux and more oxygen in the steam because of radiolysis of the water. It is therefore necessary that the fuel element cladding be of corrosion-resistant material. Examples of failures of stainless-steel claddings are given along with promising high-nickel alloys and high-purity stainless steels. (R.E.U.)

42211 PLUTONIUM CARBIDE FUELS FOR HTGRs. Sidney Langer (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nucleonics, 21: No. 9, 73-5 (Sept. 1963).

The problems encountered in the use of plutonium in high-temperature gas-cooled reactors result from several of the physical and chemical properties of plutonium and of the plutonium–carbon system. It is concluded from vapor-pressure data that stabilization of plutonium carbide, by solid-solution formation, is necessary. Experimental data on the phase relations and diffusion in plutonium carbide fuel systems are needed before the practicality of plutonium-fueled HTGRs can be assessed. (R.E.U.)

42212 DELAYED PHOTONEUTRONS IN THE BERYLLIUM REACTOR BR 02. Wilhelm Rotter (CEN, Mol, Belg.). Nukleonik, 5: 227-36(Sept. 1963). (In German)

After the shut down of the reactor BR 02 the residual flux decay curve was plotted for different places in the reactor and in the reactor core. These decay curves of the photoneutrons were approximated by a sum of the exponential functions. The exponential coefficients of the terms of the sum were practically identical with the decay constants of the responsible fission products or the parent substance. The choice of these exponential coefficients, as well as the intensities of the photoneutron groups, was found with help of an approximation according to the method of the smallest quadrant. From the size of the deviation of the measured points, the statistical distribution of the sign of this deviation was observed. The standardization followed with the help of the known groups of delayed neutrons, which could be assumed in the group relation measured by Keepin. The measured intensities were compared with calculated values. For those groups whose gamma emitters are well known, a relationship between the local intensity and the average photoneutron energies was found. With the help of this dependence the average photoneutron energies for those groups whose gamma emitters are still unknown could be determined. In this manner, in the BR 02, 16 photoneutron groups with half lives between 16 sec and 12.8 days were established. The saturation intensity of all photoneutron groups in the reactor core amounted to 2.3% of the delayed neutrons. (tr-auth)

42213 DETERMINATION OF THE STABLE REACTOR PERIOD IN REGION OF A NEUTRON SOURCE. Theodor Huerlimann and Paul Schmid (Eidgenossische Institut für Reaktorforschung, Würenlingen, Switzerland). Nukleonik, 5: 236-9(Sept. 1963). (In German)

The influence of an external neutron source on the reactor period was investigated. It is shown that the stable period can be determined with the help of a simple extrapolation method. In it the reciprocal value of the instantaneous period was plotted against the ratio of source power to observed power. The measured points lay on a straight line, which hit the ordinate at the reciprocal stable period. The method was illustrated in measurements on SAPHIR. (tr-auth)

42214 THE IMPULSE CORRELATION BETWEEN TWO NEUTRON DETECTORS IN THE STATIONARY REACTOR. Horst Borgwaldt and Dieter Sanitz (Kernforschungszentrum,

Karlsruhe, Ger.). Nukleonik, 5: 239-49(Sept. 1963). (In German)

The correlation of impulses of two neutron detectors in a stationary reactor, as they were measured in the Rossi α experiment, was considered. For the generating function of the detector counting a first-collision relation, that is, a generalization of the integral Boltzmann equation, was formulated and from it an exact expression for the space-energy and detector-dependent impulse correlations was derived. The individual terms of this expression describe the different causes of the correlation (neutron chains, spontaneous fission, and detector influence). The dependence of the delay time corresponds exactly to the time distribution of the detector impulse in an experiment with a pulsed neutron source. The calculation of the impulse correlation yielded the solution of a binary Boltzmann equation and agrees in that essentially with the classical reactor theory. The projection of the binary neutron density to the persistent eigenfunction of the Boltzmann operator allows the determination of the basic mode for reducing the known equations. (tr-auth)

42215 STUDIES ON TRANSIENT HEAT TRANSFER IN THE HETEROGENEOUS WATER REACTOR. PART 1. Shigenori Hayashi, Akira Sakurai, and Tetsuo Iwazumi. Tech. Rept. Eng. Res. Inst., Kyoto Univ., 8: 85-105(May 1963).

When a sudden excess reactivity is introduced into a heterogeneous water reactor, the reactor power increases as an exponential function and the fuel-plate temperature rises rapidly. In many reactors, however, the reactor power does not infinitely increase as an exponential function, but the self-shutdown will be induced by the thermal energy increase in the reactor with increasing reactor power. Finally, the reactor power stops to increase. As the fundamental problems in the analysis of these reactor kinetics, experimental and theoretical studies were performed on the transient heat transfer between the fuel and the coolant when the reactor power increased exponentially. The methods applying the above mentioned results to the analysis of the reactor kinetics during a power excursion are shown. The experiments show a good agreement with the analysis. (auth)

42216 REACTOR CONTAINMENT VESSELS—DESIGNS AND PROTECTIVE ACTION. Theodor Sanders. Tech. Ueberwach., 4: 357-63(Oct. 1963). (In German)

In case of power and research reactors subject to given safety requirements the design of any specific containment vessel will depend on the particular location in which it is installed. There are different designs for low population areas and where certain special requirements are to be met, for instance plain buildings and noncontrolled and controlled fission-products disposal, standard safety vessels, containment vessels for the total plant, vessels of the pressure relief and pressure suppression type, and underground designs. For locations near or in metropolitan areas it appears that no tank other than the double safety vessel is required for power reactors of the boiling and pressurized water type. (auth)

42217 SAFETY PROVISIONS IN NUCLEAR TEST REACTOR PLANTS. Walter Stuermer (Brown Boveri Krupp Reaktorbau GmbH, Mannheim, Ger.). Tech. Ueberwach., 4: 364-9(Oct. 1963). (In German)

The operation of nuclear power plants may involve considerable hazards, but safety provisions of particular extent make sure that such installations are at least as safe as plants of conventional design. The essential safety provisions that prevent troubles in the reactor core, consequences of damages to the steam generator, and reactor vessel excessive loading are described. (auth)

42218 FLUX FLATTENING EXPERIMENTS ON HEAVY WATER CRITICAL FACILITIES. F. Accinni and G. B. Zorzoli (CISE, Milan). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/83, 26p. (CONF-133-30)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

Thermal-flux and Cd-ratio measurements in a heavy-water critical facility with 3 different geometries are presented. The geometries are outer reflected, inner and outer reflected, and with a black body inserted into the inner reflector. Experimental results and theoretical calculations are compared. It is possible to achieve core thermal-flux flattening, without high reactivity losses and changes in core neutron spectrum, by means of a black body inserted into the inner reflector. (auth)

42219 REACTOR PHYSICS DEVELOPMENT FOR ADVANCED GAS COOLED REACTORS. J. Moore (United Kingdom Atomic Energy Authority, Windscale, Sellafield, Eng.). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/49, 36p. (CONF-133-26)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

The detailed experimental and theoretical work that has been done during design, development, and commissioning of the Windscale A.G.R. and in general support of development of Advanced Gas Cooled Reactors for civil power production is reviewed. The considerable amount of work that has been necessary to develop adequate theoretical methods for calculating flux distribution and reactivity balance in a complex reactor core, power distribution in complex fuel geometries, and the effect of irradiation on fuel cycles and power distribution is described. The approach to critical facility, APEX, and the zero energy reactor, HERO, have been used with regular lattice arrangements and with combinations of perturbers such as control rods in them to determine lattice parameters for A.G.R. and to check the theoretical methods developed for dealing with heterogeneous reactor cores. Measurements on a number of different sized "reactor" cores in APEX and HERO were analyzed to determine a self-consistent set of lattice constants that fitted the experimental results. These purely empirical constants were used to plan commissioning and choice of the loading pattern for the Windscale A.G.R. The experimental techniques used for measurement of reactivity effects in APEX, HERO, and A.G.R. and for determining fine structure data and power distribution in the complex fuel assemblies are discussed. Current and future theoretical work is concentrated primarily on development of an alternative theoretical method for dealing with reactor cores after considerable burn-up of the fuel. The experimental program on HERO is designed to test the methods with complex cores including Pu-bearing fuel. Additional information on the effect of Pu will be derived from operation of A.G.R. and physics measurements on fuel after irradiation. (M.P.G.)

42220 RESEARCH WITH A NATURAL URANIUM-LIGHT WATER SUBCRITICAL ASSEMBLY. H. Koskinen (Inst. of Physics and Tech., Otnaiemi, Finland). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/50, 28p. (CONF-133-28)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

Research with a natural-U light-water assembly is reported, and some topics on the future program are presented. Work on the assembly has been concentrated on two main objectives: experimental study of the validity of calculation methods to be used in cases of special geometries; and study of special properties of natural-U light-water lattices and especially of the validity of few-group slowing-down models for both uniform and nonuniform core structures. It is believed that an assembly with only a spontaneous fission source is particularly suitable for research of this kind, and the reasons for this are discussed. Through analysis of the flux distributions in such a system, information about the validity of special slowing-down models can be obtained. In the author's opinion, the liquid-moderated subcritical assembly, because of its versatility and safety, is nearly the only possibility for systematic study of nonuniform lattices. In the future, enriched elements will be included in the assembly. Then systematic study of mixed lattices becomes possible, and research with other nonuniformities will be easier because of the higher flux. (M.P.G.)

42221 CONSTRUCTION, COST AND USE OF AN ENRICHED URANIUM–LIGHT WATER SUBCRITICAL ASSEMBLY. B. Vittoz, Ph. Berthet, P. Gavin, Ch. Mandrin, Ph. Robert, and J. Thurnheer (Univ. of Lausanne, Switzerland). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/8, 27p. (CONF-133-9). (In French)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

Designed for the experimental investigation of multiplying lattices, the Lausanne subcritical assembly is also used for teaching purposes. It is extremely versatile. The reasons for selecting a slightly enriched-U light-water lattice are discussed. The U rods are vertically suspended, and each suspension point has 2 degrees of freedom and can be continuously varied. Hence the lattice spacing can be continuously varied. The neutron input is provided by 5 Pu–Be sources placed in a graphite base, and their spacing can also be continuously regulated. Safety problems and construction and operational costs are discussed. The facility is used, inter alia, to study a nonperiodic lattice with a view to obtaining a uniform flux. (M.P.G.)

42222 CRITICAL EXPERIMENTS AS A MEANS OF EXPOSING THE PHYSICAL CHARACTERISTICS OF A REACTOR. V. A. Kuznetsov. Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/86, 13p. (CONF-133-33). (In Russian)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

Criticality studies were made of intermediate reactors in order to determine physical properties of certain reactor types. An analysis was made of experimental data on reflector efficiency, heterogeneity effects, reactivity coefficients, and neutron lifetimes, and ideas are forwarded on the feasibility and perspectives of experimental data utilization in developing reactor theory and calculation methods. (tr-auth)

42223 INVESTIGATION OF PHYSICAL PROPERTIES OF THE ACTIVE ZONE IN THE WW-PR AT CRITICALITY. G. Ya. Andrianov, V. A. Voznesenskii, A. N. Kamyshan, L. V. Komissarov, V. A. Kuz'micheva, G. L. Lunin, V. N. Semenov, and V. I. Khalizev. Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/89, 40p. (CONF-133-11). (In Russian)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

Critical experiments in the active zone of VVER showed that homogeneous multiplying lattices are well described by the critical equation up to the material parameter $\mathfrak{B}_0^2 = 60 \times 10^{-4}$ cm^{-2}. The magnitude η, describing the deviation of critical conditions from one-group, was equal to 1.04 ± 0.08. Results of experimental determinations of K_∞ and $\mathfrak{B}_0^2$ for an assembly of 1.5 and 2% enriched fuel elements and for a mixed assembly were in good agreement with theoretical calculations. Variation in absorber efficiency indicates that fuel rod distribution effects reactor geometry parameters. (R.V.J.)

42224 AN INVESTIGATION OF THE INCREMENT OF NEUTRON-FLUX DENSITY OBTAINED IN THE BREEDING ZONES BY THE ADDITION OF AN OUTER REFLECTOR MADE OF VARIOUS SUBSTANCES. M. N. Nikolaev, A. V. Zvonarev, V. I. Golubev, and M. Yu. Orlov. Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/87, 29p. (CONF-133-32). (In Russian)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

An additional outer reflector was installed in order to prevent excessive neutron leakage from the breeding zone. The reflector creates a neutron flux increment that increases the capture efficiency. Results are given of an investigation of the influence of various material reflectors on the number of captures in the breeding zone. The experiments were carried out during BR-1 critical operation. (R.V.J.)

42225 A SUB-CRITICAL EXPERIMENT FOR AN AQUEOUS HOMOGENEOUS SUSPENSION REACTOR. J. A. H. Kersten and J. J. Went (N. V. Kema, Arnhem, Netherlands). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/78, 27p. (CONF-133-24)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

In circulating fuel reactors, a subcritical or near-critical experiment, instead of an exponential or critical experiment, has proved to be of great value. In such a reactor, it is essential to keep the concentration and concentration distribution of the fuel during constant operational conditions between very narrow limits. Conventional concentration measuring devices are far too insensitive. Only the determination of the reactivity near the critical point can give the desired information. With a subcritical suspension reactor that could be operated at constant temperature, it was also possible to measure other important properties of the reactor system. Results are given from measurements on the influence of the colloid chemical properties of the suspension on the noise of the neutron flux, on the recoil separation efficiency of fission products, and on the temperature coefficient of reactivity. The effective delayed neutron fraction as a function of the circulating velocity of the suspension and the flux distribution inside the reactor vessel are also determined. (M.P.G.)

42226 EXPERIENCE AT BROOKHAVEN IN THE MEASUREMENT OF CELL PARAMETERS. G. A. Price (Brookhaven National Lab., Upton, N. Y.). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/27, 37p. (CONF-133-16)

From International Atomic Energy Agency Symposium of

Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

The Reactor Physics Group of Brookhaven National Laboratory has been involved for several years in the measurement of cell parameters in slightly enriched U–ordinary water reactor systems. Measuring techniques have been developed and applied to a wide range of fuel-rod sizes and moderator-to-fuel volume ratios. The measurements of the thermal neutron disadvantage factor, ξ, the fast-to-thermal fission ratio, δ_{25}^{28}, and the epi-cadmium to sub-cadmium U^{238} neutron capture ratio, ρ_c^{28}, are treated. The evolution of experimental methods, the developmental experience associated with them, and the subsequent reduction of experimental uncertainties are discussed. The methods are described in detail, including some comparisons of similar techniques at other laboratories, and illustrative data are given. (M.P.G.)

42227 INTERACTION OF MACROSCOPIC FLUX AND FINE STRUCTURE IN HETEROGENEOUS REACTORS. P. Benoist and P. F. Palmedo (Commissariat à l'Energie Atomique, Saclay, France). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/66, 27p. (CONF-133-29). (In French)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

It is usually assumed that the space dependent flux, $\Phi(\vec{r})$, in heterogeneous reactor systems is separable into a macroscopic function, $\psi(\vec{r})$, and a microscopic function, $\phi(\vec{r})$, $\phi(\vec{r})$ being the "fine structure" in an infinite system. It is known that this assumption is inexact. It is shown here that the flux may be expressed as: $\Phi(\vec{r}) = \psi(\vec{r}) \times \phi(\vec{r}) - \vec{\nabla}\psi(\vec{r}) \times \vec{\phi}_1(\vec{r})$. An expression is given for $\vec{\phi}_1(\vec{r})$, which is shown to depend in a simple way upon the radial diffusion coefficient, D_r. Experiments performed on Aquilon II are reported, which examine the interaction of macroscopic and microscopic fluxes in various U–D_2O lattices. The form of the equation is verified, and the possibility of determining D_r experimentally is investigated. (auth)

42228 USE OF A SUBCRITICAL ASSEMBLY FOR THE ACTIVE AND PASSIVE SURFACE TECHNIQUE. Ch. Mandrin (Univ. of Lausanne, Switzerland). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/7, 43p. (CONF-133-10). (In French)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

To study a heterogeneous multiplying medium, it may be divided into a number of homogeneous regions having the diffusion and absorption properties of the pure moderator. The fuel elements, represented by portions of active surfaces of zero thickness, constitute the separation surfaces of these sub-regions. Externally, the system is bounded by passive surfaces devoid of fissionable nuclei. The theory of diffusion involving several groups of neutrons is applied to each sub-region, while the productive and absorbing effects of fissionable materials are represented by the conditions on the active surfaces. To apply the method, certain parameters of the behavior of an active surface in a known flux must be known. A single exponential experiment, carried out with a very small number of rods, should suffice to determine these parameters experimentally. The subcritical assembly used for these experiments is described. Measurements made for a series of different configurations confirm that the parameters sought depend solely on the nature of the fuel. The results are used to forecast the behavior of a subcritical and a critical lattice. (M.P.G.)

42229 ON THE SUBCRITICAL ASSEMBLY FOR HIGH TEMPERATURE USE. Y. Sakurai (Osaka Univ.). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/3, 12p. (CONF-133-5)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

A graphite-moderated subcritical assembly using natural U fuel is described. The special design is characterized by a high temperature portion, which can be put into the center of the lower temperature core assembly. The assembly is used for the study of high-temperature gas-cooled reactors and direct energy conversion from a high-temperature gas medium to electricity and for the training of undergraduate students. The 1 m^3 high temperature portion is energized by joule heating and can be maintained at temperatures up to 2000°C. UO_2 pellets are used for the low temperature portion and UC_2 pellets for the high temperature part. An Am–Be source of 5 C is located at the bottom of the assembly, and pulsed neutrons are injected at an arbitrary point inside the assembly. The assembly is equipped with control and measuring systems comparable to those of small-scale nuclear reactors. The buckling constant of the system, and the best arrangement of the pulsed neutron source, and detector locations are being investigated experimentally. A unique method of measuring the neutron flux density at high temperatures is being developed, and the influence of high temperatures on reactor parameters is being studied. (M.P.G.)

42230 BUCKLING MEASUREMENT IN AN EXPONENTIAL EXPERIMENT. E. Rodriguez Mayquez (Junta de Energía Nuclear, Madrid). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/48, 7p. (CONF-133-12). (In Spanish)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

The method of data processing now being used in the laboratories of the Junta de Energía Nuclear (Nuclear Energy Board), Madrid, for determining the buckling in an exponential experiment is described. The method is based on a least squares operation on the flux values measured at different points, which makes it possible to eliminate the contributions due to harmonics as well as other disturbances. (auth)

42231 PULSED NEUTRON MEASUREMENTS ON A HEAVY WATER REACTOR AT ZERO ENERGY. M. Kuechlo (Kernforschungszentrum, Karlsruhe, Ger.). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/6, 16p. (CONF-133-4)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

During the start-up of the research reactor FR2, reactivity measurements with a pulsed neutron source were made. Because of the relatively long lifetime of the neutrons in a D_2O system, a correction for the build-up of delayed neutrons during the prompt neutron decay was applied. From measurements of the subcriticality as a function of the water level and extrapolation to the full tank, the excess reactivity of the reactor was obtained. The result agreed well with that of a boron poisoning technique. Many reactivity measurements were made, but only control rod calibration curves for different control rod combinations are reported. (auth)

42232 SUBCRITICAL REACTIVITY MEASUREMENT BY PULSED NEUTRON SOURCE METHOD. T. Naganuma, S. Ogura, T. Kondo, K. Hayata, M. Mukae, and M. Sugeno

(Mitsubishi Atomic Power Industries, Inc., Ohmiya, Japan). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/2, 20p. (CONF-133-6)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

In a light-water-moderated and natural-UO_2-fueled subcritical facility, exponential experiments and pulsed-neutron-method experiments were performed to measure k_{eff}. The major purpose of the study was to develop and improve the pulsed neutron method to be applied to basic study of cores of light-water-moderated and slightly enriched-UO_2-fueled power reactors. In cores of this type, several higher modes of neutron flux remain over almost the full range of the time-decay curve, making the usual pulse neutron methods not applicable for measuring the subcritical reactivity. The decay constant of the pure fundamental mode was analyzed, separating it from observed time-decay curves. Measurements were made using the exponential-experiment method and the pulsed-neutron method at the core location considered to have the maximum k_{eff}. A reflector saving of the core was determined from the exponential experiments by fitting measured flux distribution to the standard formula for buckling. In the pulsed neutron method, the fundamental mode was extracted by analyzing time-dependent neutron-flux spatial distribution curves. The measured k_{eff} values of the core were 0.796 ± 0.002 and 0.814 ± 0.015, respectively, for the exponential experiment and the pulsed-neutron method. A theoretical calculation based on the modified four-factors theory predicted 0.8143 for the k_{eff}. (M.P.G.)

42233 USE OF AN EXPONENTIAL ASSEMBLY TO INVESTIGATE BOUNDARY CONDITIONS IN NEUTRON DIFFUSION. C. G. James and P. J. Grant (Imperial Coll. of Science and Tech., London). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/1, 22p. (CONF-133-7)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

It has been established that valid measurements of control rod effectiveness can be made in an exponential assembly, and the method has been used to investigate the influence of environment on control-rod worth. Measurements in unfueled and fueled systems have been used to deduce thermal and epithermal extrapolation distances for the rods, and these values are compared with theoretical predictions. Zoning of the stack has been used to examine boundary conditions between fuel regions having different nuclear properties and between fueled and unfueled regions. (auth)

42234 NUCLEAR CALCULATIONS OF LIGHT WATER MODERATED REACTORS AND EXPERIMENTAL CORRELATIONS. R. Solanilla (Comisión Nacional de Energía Atómica, Buenos Aires). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/25, 37p. (CONF-133-18). (In Spanish)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

Using the theory of 2 groups modified by epithermal fissions, a set of critical systems, comprising a reflector, a light water moderator, and nuclear fuel consisting of U^{235} in various degrees of enrichment, was analyzed. The calculations were performed by computing the effective resonance integral of U^{238} by the formula obtained theoretically by the author. Theoretical and experimental results were correlated over a wide range of moderation, composition of materials, and geometry. Satisfactory results were obtained, with variations of generally not more than 2% between calculated and experimental reactivity. (M.P.G.)

42235 THE EXPO EXPONENTIAL FACILITY. H. Neltrup and P. L. Oelgaard (Research Establishment, Risö, Denmark). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/53, 32p. (CONF-133-13)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

An account of the philosophy behind the construction of the EXPO Facility is presented. A description of the facility is given, and the experimental program and operational experience are discussed. (auth)

42236 IMPROVED TECHNIQUES FOR LOW FLUX MEASUREMENT OF PROMPT NEUTRON LIFETIME, CONVERSION RATIO AND FAST SPECTRA. R. J. Armani, E. F. Bennett, M. W. Brenner, M. M. Bretscher, C. E. Cohn, R. J. Huber, S. G. Kaufmann, and W. C. Redman (Argonne National Lab., Ill.). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/32, 41p. (CONF-133-21)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

Various statistical methods for the measurement of the ratio of prompt neutron lifetime to delayed fraction have been used in the ZPR program. The areas of most advantageous application of the various methods have been studied. Attention has also been given to the interpretation of the results of these measurements, and it has been shown that interpretation based on a simple kinetics model is applicable to a wide range of practical cases. Several improvements in the original activation method for the low flux determination of the ratio of production to destruction of fissile material are described. Obtaining a value for conversion ratio from the activation data requires a knowledge of the ratio of captures to fissions in the fuel. No accurate experimental method now exists for the measurement of this quantity in a low flux reactor, but several methods which might make feasible such a determination are being explored. Three of the more promising techniques are outlined. Efforts to develop a small fast neutron spectrometer of good stability, resolution, and sensitivity for in-pile measurements of neutron spectra in the energy region of tens and hundreds of kilovolts have been concentrated on the use of pulse-shape analysis to reject γ-ray initiated events in H recoil proportional counters and the introduction of collimation in Li^6F-solid state detector sandwiches to improve the resolution obtained. A number of such instruments have been built and their response to monokinetic and reactor neutrons investigated. (M.P.G.)

42237 MIT EXPONENTIAL LATTICE STUDIES (LOW ENRICHMENT-HEAVY WATER LATTICES). I. Kaplan, D. D. Lanning, A. E. Profio, and T. J. Thompson (Massachusetts Inst. of Tech., Cambridge). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/31, 62p. (CONF-133-17)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

An experimental and theoretical research program on exponential lattices of normal and partially enriched U rods moderated by heavy water is discussed. The special technique developed to supply neutrons from the horizontal thermal column of M.I.T. Research Reactor to the expo-

nential tank, which has a vertical axis, is described. Several volume ratios can be investigated. Measurements of buckling, resonance capture, conversion ratio, and fast fission are made, as well as intracell thermal flux distributions with spectrum-sensitive detectors. The experiments have shown where improvements in calculations are necessary, e.g., in treatment of the cell boundary in the thermal flux space-energy distribution. Most measurements are made by foil activation. A number of techniques have been developed, including a coincidence counting method for the measurement of Np-239 activity in resonance capture experiments, La^{140} fission-product counting for fast fission experiments, and thermal flux plots using foils of Au, Lu, and Eu. Results, including bucklings, are available for 2.5 cm normal U metal and 0.65 cm 1.027% enriched metal. Preliminary and future work is outlined. (M.P.G.)

42238 PULSED-SOURCE MEASUREMENTS ON A URANIUM–WATER SUB-CRITICAL ASSEMBLY. I. H. Gibson and J. Walker (Univ. of Birmingham, Eng.). Vienna, International Atomic Energy Agency, 1963. Preprint Sm-42/11, 17p. (CONF-133-8)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

An unreflected assembly of natural U and light water has been used in conjunction with a pulsed source of neutrons for decay-time measurements at different bucklings. Four different lattice pitches over the range 3.94 cm to 5.08 cm were obtained by using different pairs of accurately machined lattice plates. In each case the U was in the form of bars 109.8 cm long and 3.0 cm diameter. The fuel was mounted horizontally and loadings up to ~6 tons were involved. Spatial harmonics were eliminated or selected by appropriate placing of a small scintillation detector. Experimental results showing the dependence of a decay constant on buckling are presented and compared with theoretical values. (auth)

42239 UO_2-TYPE FUEL ELEMENTS FOR WATER COOLED REACTORS. MANUFACTURING AND COST CONSIDERATIONS. L. Halle, S. Brandberg, and A. W. Magnusson (ASEA, Nuclear Power Dept., Vasteras, Sweden). 34p. (CONF-193-5)

From 8th Nuclear Congress, Rome, June 1963.

A substantial number of the nuclear power reactors now in operation are of the water-cooled type using UO_2-fuel canned in Zircaloy-2 or stainless steel. Facilities and methods for the production of this type of fuel elements are described with reference to the experience obtained at the ASEA Fuel Element Production Plant in Vlsterås, Sweden. The processes described include powder preparation, pelletising, canning, assembly, etc. The fabrication costs for fuel elements have a marked influence upon the fuel-cycle cost and thereby on the competitiveness of nuclear power. The costs of materials and different fabrication stages are discussed, and some cost-consuming operations such as control and non-destructive testing are analyzed and related to present specifications. Special interest is devoted to the economic consequences of such factors as narrow tolerances and surface quality of autoclaved Zircaloy-2 material. (auth)

42240 DEVICE FOR MEASURING THERMAL NEUTRON FLUX. (to Atomic Energy of Canada Ltd.). British Patent 938,994. Oct. 9, 1963. Priority date Apr. 15, 1960, United States.

An apparatus for measuring the thermal neutron flux of a nuclear reactor that has a radiation path from the active lattice of the reactor to a thermal neutron detector is presented. The path includes a thin hydrogenous scatterer having a high hydrogen content placed in the path and at an angle to it. The thermal neutrons are scattered to the detectors. The detectors are positioned in relation to the scatterer so as to receive the thermal neutron and substantially no other radiation. (C.E.S.)

42241 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENTS. John Frederick William Bishop and Ernest Smith (to United Kingdom Atomic Energy Authority). British Patent 939,183. Oct. 9, 1963. Filed Jan. 21, 1960.

A reactor fuel tube is presented that has growth-accommodating voids provided by recesses on the faces of the heat-insulating members in contact with the ends of the fuel element. (C.E.S.)

42242 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Eric John Robbins (to United Kingdom Atomic Energy Authority). British Patent 939,714. Oct. 16, 1963. Filed Oct. 17, 1961.

A method of detecting leaks in nuclear fuel elements consisting of fuel rods enclosed individually in protective sheaths and located in channels in a gas-cooled reactor so that coolant flows over the elements is described. The protective sheaths that enclose the fuel rods also contain an inert gas. The inert gas in the coolant after it leaves the channel is determined by mass spectrometry. An increase in inert gas concentration in the coolant indicates a leaking fuel element. (M.C.G.)

42243 DRIVE MEANS FOR REGULATING AND EMERGENCY CONTROL RODS IN HETEROGENEOUS NUCLEAR REACTORS. (to Allmanna Svenska Elektriska Aktiebolaget). British Patent 939,973. Oct. 16, 1963. Priority date Aug. 24, 1960, Sweden.

A control-rod drive mechanism is described that consists of a motor-driven screw and a nut threaded on the screw and received in a tube that is able to carry out at will either regulating control operation or emergency control operation. The drive is characterized by means in the assembly for normally holding the rod connected with the nut for the function of the rod as a regulating control rod and for releasing the rod from the nut along the axis of the tube and by electromagnetic means for holding the rod in this position in readiness for its function as an emergency control rod. (M.C.G.)

42244 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Norman Battle and Geoffrey William Duffin (to Rolls-Royce Ltd.). British Patent 939,982. Oct. 16, 1963. Filed May 16, 1961.

A reactor is described in which the calandria tank is supported within the shielding by being suspended from a top shield structure by means of the fuel channels that house the fuel elements and through which coolant flows. The fuel channels include tube parts which extend through passages in the top shield structure and are engaged at their upper ends with the top shield structure by individual arrangements permitting adjustments so that all fuel channels assist in transmitting the load of the calandria tank to the top of the shield structure. The fuel channels also extend freely through passages in a bottom shield structure and the top shield structure is supported by the bottom shield structure. The reactor illustrated is liquid moderated and steam cooled. (M.C.G.)

42245 METHOD OF ENRICHING AND UTILIZING NUCLEAR FUELS. K. Diebner. French Patent 1,225,613. Feb. 22, 1960. Filed Nov. 15, 1956.

It is proposed that natural uranium that has been irradiated in a nuclear reactor until a quantity of plutonium has been formed be used as a fuel in a light water moderated power reactor for ship propulsion. (NPO)

42246 CONTAINER WITH A MAGAZINE FOR CHARGING AND DISCHARGING OF A HORIZONTAL CHANNEL OF A NUCLEAR REACTOR. (to Commissariat a l'Energie Atomique). French Patent 1,229,672. Sept. 8, 1960. Filed Oct. 21, 1958.

Irradiation devices with sample holders fixed at the inner extremities of the shielding plug obturating the outer end of a horizontal reactor channel are known. Machines are described for charging and discharging these samples of the kind comprising a casing enclosing a rotatory mounted cylindrical magazine provided with at least two cylindrical excentric cavities, which by rotation of the magazine may be brought successively into alignment with the reactor channel to be disserved. Each cavity encloses a cylindrical liner adapted to rotate with respect to the magazine. This rotation is controlled, using a gear train, by the rotation of the magazine, in such a way that the orientation of the liner with respect to space remains the same whatever the position of the corresponding cavity may be. This measure ensures that each plug to be disserved and which is adapted to be connected to suitably self-propelled carriages movable inside the liner, has a stationary orientation in space during the handling process. (IIB)

42247 ARRANGEMENT FOR MEASURING THE TEMPERATURE OF A FUEL ELEMENT SITUATED IN THE INTERIOR OF AN ATOMIC REACTOR. (to Societe Alsacienne de Constructions Mechaniques). French Patent 1,230,588. Apr. 4, 1960. Filed Mar. 31, 1959.

The fuel element, the temperature of which is to be measured by means of a built-in thermocouple, is suspended from a separate support member with spring-loaded spider arms that engage a transversal groove in the moderator channel. The thermocouple leads are connected with two spring-loaded electrical contact members on the said support member, the contact members contacting second contact members that are fixed in said groove and that are connected with the measuring instrument. (NPO)

42248 IMPROVEMENTS RELATING TO SYSTEMS FOR HANDLING FUEL ELEMENTS OF A NUCLEAR REACTOR. (to Commissariat a l'Energie Atomique). French Patent 1,234,243. Oct. 14, 1960. Filed May 13, 1959.

A handling device for fuel elements of a nuclear reactor comprises, in a plane perpendicular to the fuel element axis, two cylindrical parts with their axis parallel to the fuel element axis. One of these cylinders is eccentrically mounted in the other one. The inner cylinder is provided with two access holes in such a way that by an appropriate rotation of these cylinders about their axis, each of these holes may be brought into alignment with a fuel element so that each hole may disserve a corresponding zone of the reactor. Preferably there is also a zone in which the fuel elements may be disserved by both access holes. (IIB)

42249 DEVICE FOR THE HANDLING OF FUEL ELEMENTS OF A NUCLEAR REACTOR. (to Commissariat a l'Energie Atomique). French Patent 1,234,766. Oct. 19, 1960. Filed May 19, 1959.

The top shield of the reactor is provided with a system of two rotating plugs, one of which is provided with an access hole which, by the rotation of the plugs, can be brought into alignment with any fuel element of the reactor. The inner plug houses a hoisting winch placed in the upper portion of the access hole and mounted on a shielding plug occupying the remaining portion of that access hole. This shielding plug is extended at its bottom by a tube reaching down to the top of the reactor core, while the cable of the hoisting winch passes through a channel system in the shielding plug and supports at its lower end a grip adapted to couple with the handling head of a fuel element. This channel system comprises pulleys for the cable following a passage changing its direction at each pulley and a liquid seal in order to ensure the fluid tightness of the cable passage. Preferably, this liquid seal is of a construction allowing its disassembly without any liquid losses. (IIB)

42250 ELECTRO-HYDRAULICALLY CONTROLLED MULTIPLE DISTRIBUTING DEVICE. (to Recherches Etudes Production). French Patent 1,234,773. Oct. 19, 1960. Filed May 19, 1959.

For burst-slug detection, nuclear reactors are provided with systems for taking cooling fluid samples from the different reactor channels and leading them through a system of sampling lines and fluid distributing means to the measuring instruments. Such distributing means consists of a electrohydraulically controlled multiple distributing device assembling in the same body a series of double valves generally composed of identical parts. Each double valve corresponds to one entrance and to two exists of the device and has double control means comprising electrovalves and hydraulic jacks. The common valve body from which branch all the entrance and exit lines has cylindrical cavities into which the valves are mounted in such a manner that they can be easily rechanged. (IBB)

42251 ACTINIDE METAL SOLS AND THEIR APPLICATIONS. (to Diamond Alkali Co.). Addition to French Patent 1,235,603. Nov. 6, 1961. Priority date Nov. 12, 1958, United States.

The rise of thermally stable hydrous metal oxide sols with a concentration superior to 200 g/l, pH = 3-6.5, and an adjusted particle size between 10 and 100 millimicrons as fuels in homogeneous reactors is discussed. The sols are prepared from metal salt solutions by addition of a seed sol and a weak anion exchange resin. They are stabilized by heating above 250°C under continuous agitation. (NPO)

42252 HEAT EXCHANGER TUBES WITH A RUGGED SURFACE. A. Huet. French Patent 1,252,033. Dec. 19, 1960. Filed Apr. 28, 1959.

Metallic or ceramic tubes, the exterior surface of which shows a great number of irregularly distributed indentations, and elevations of small depth and height, were developed. The tubes are to be used as heat exchange elements or as jackets for nuclear fuel rods. (NPO)

42253 BALLISTIC VALVE CONTROLLED BY A PERCUSSION. (to Commissariat a l'Energie Atomique). French Patent 1,260,733. Apr. 4, 1961. Filed Mar. 31, 1960.

A ballistic valve controlled by a percussion may serve as an insulating valve for the sampling pipes of burst slug detection systems. The closing piece of the valve moves axially between two stable positions (open and closed) and is mounted on a rod connected with a snap-action lever system holding the rod with the closing piece in one of its stable positions. In each of these positions one end of the rod rests against a special spot of the valve casing, so that a percussion from outside at this spot provokes a jump of the rod into the other stable position. (IIB)

42254 IMPROVEMENTS RELATING TO BURST SLUG DETECTION SYSTEMS IN NUCLEAR REACTORS. (to

Société Indatom). French Patent 1,263,969. May 8, 1961. Filed May 4, 1960.

Undesirable intermixing of sample flows is prevented by a fluid pressure equalization system holding the pressure in the different sampling pipes for the different fuel element channels at the same level. This system generally consists in ensuring simultaneous parallel flows from all the column headers of the same pipe matrix. (IIB)

42255 IMPROVEMENTS IN NUCLEAR FUELS FOR SINGLE PHASE BREEDER REACTORS, AND IN METHODS FOR THE PRODUCTION OF SUCH FUELS. (to W. R. Grace and Co.). French Patent 1,264,960. May 15, 1961. Filed Aug. 11, 1960.

Thermally stable hydrous UO_2/ThO_2 sols, the colloidal particles of which are coated with a SiO_2 film to give the particles a negative charge, were used as nuclear fuels. The sols should be practically void of electrolytes and have a pH = 7.0–11.0. They are prepared by electrodialyzing an aqueous solution of U/Th salts containing 5–10% Th as ThO_2 and 0.2 – 1% U as UO_2, rapidly mixing the resulting electrolyte-free sol with an electrolyte-free SiO_2-sol, SiO_2 being 10:1 – 1:1, adjusting the pH, and concentrating to the preferred density = 1.5. (NPO)

42256 ARRANGEMENT FOR THERMAL TRANSFER. (to Commissariat a l'Energie Atomique). French Patent 1,266,512. June 5, 1961. Filed May 27, 1960.

Tubular heat exchange elements, notably fuel rod cans, that are provided with helical fins and longitudinal splitters are improved by the applications of a number of supplementary longitudinal splitters at one of their extremities, the length and depth of the supplementary splitters being so that the heat exchange coefficient of the element is nearly constant over its entire length. (NPO)

42257 FUEL ELEMENT FOR NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,266,814. June 5, 1961. Priority date Sept. 4, 1959, Great Britain.

An end cap is joined to a tubular fuel element sheath by a series of at least two spaced welds. One of the welds is at the circumference of the tube and the other between the contacting surfaces of sheath and cap. The possibility of leakage is thus diminished. (NPO)

42258 BURST SLUG DETECTION DEVICE ADAPTED FOR AN INDEPENDENT LOOP DISPOSED INSIDE A NUCLEAR REACTOR. (to Commissariat à l'Energie Atomique). French Patent 1,269,633. July 10, 1961. Filed May 20, 1960.

Burst-slug detection systems are known comprising a cylindrical electrode onto which ionized daughters of short-lived fission products are precipitated and afterwards are brought in front of a scintillation counter by a rotation of this electrode. It is shown that the surface of the electrode additionally shows at least one cavity adapted to enclose, together with the casing of the electrode, a given volume of the carrier gas from which the daughter products are precipitated and to bring it in front of the scintillation counter. In this way the measurement may be performed on the concentration of long-lived fission products. (IIB)

42259 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,276,327. Oct. 9, 1961. Priority date Dec. 29, 1959, Great Britain.

A fuel element comprising a fuel member in a protective sheath that has included within the sheath a substance, which, at a temperature above the normal operating temperature of the fuel element, expands more rapidly than the fuel member and the sheath so as to distort the latter is described. The fuel element can be provided with a strain indicator for detecting the distortion or the substance can be associated with a member for breaching the sheath at a weakened zone on expansion, causing the escape of fission products. The substance can be an adequate metal strip, such as anisotropically expanding U, or a sublimating substance, such as U iodide. The disposition enables the timely detection of leaks in the sheath during operation in a coolant that can oxidize and so thermally insulate the fuel member. (NPO)

42260 TIGHT CLOSURE OF FUEL ELEMENTS THAT ARE CANNED WITH SINTERED MATERIALS. (to Commissariat a l'Energy Atomique). French Patent 1,277,387. Oct. 23, 1961. Filed Oct. 18, 1960.

The end closure of tubular sheaths, consisting of sintered oxidized Al, Mg, or Be powder is effected in the following way. A concave cap is either screwed or pressed in the sheath, a concave counter-cap is placed on the composite, both concavities facing each other, and the three parts are welded together at their places of junction. Thereupon the counter cap is mechanically removed. (NPO)

42261 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,277,811. Oct. 23, 1961. Priority date Jan. 19, 1960, Great Britain.

A fuel element comprising a fuel member enclosed in a protective sheath and having a tubular or annular capsule containing a radioactive gas, Kr^{85} or Rn, disposed within the fuel member, is described. If the fuel element develops a leak during operation in a CO_2 cooled reactor so that the fuel member is oxidized, the insulating effect of the oxide formed causes the temperature of the fuel member to rise and the capsule to melt. This leads to release of the radioactive gas, which has a greater pressure than the coolant and so diffuses out through the leak. The resulting pulse of radioactivity in the coolant warns of a leak. (NPO)

42262 APPARATUS FOR DETERMINING THE LOCATION OF PERFORATION EEFECTS IN THE SHEATHS OF FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,283,638. Dec. 26, 1961. Priority date Mar. 15, 1960, Great Britain.

An apparatus for determining the location of perforation defects in the sheaths of fuel rods comprises a first member defining an annular draw-off groove followed by a second member defining a helical draw-off groove concentric with the annular groove, the second member comprising a tube wound in the form of a helix an slotted along its length. In operation the fuel element having a perforation defect is first placed within a pressurizing vessel where nitrous oxide gas is forced into its interior. Then the fuel element is advanced through the two members that are connected with a gas detector. Two indications of the detector gas escaping through the perforation are obtained giving the axial and angular location of the perforation. (NPO)

42263 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,286,412. Jan. 22, 1962. Priority date Apr. 19, 1960, Great Britain.

Fuel rods that are provided with helical fins and longitudinal splitters have the tendency to vibrate and rotate during operation. This tendency is obviated by fixing tubular sockets around the extremities of the element. (NPO)

42264 NON-CORROSIVE FUEL FOR NUCLEAR REACTORS, UTILIZING PLUTONIUM IN A TANTALUM CON-

TAINER. (to U. S. Atomic Energy Commission). French Patent 1,286,538. Jan. 22, 1962. Priority date Apr. 25, 1960, United States.

The application of a liquid metal fuel, consisting of 8-12 at. % Fe, 2 at. % C, and the balance Pu, in tantalum containers is discussed. The C in the fuel creates an autoregenerative film of tantalum carbide on the surface of the container, preventing its attack by the molten Pu. (NPO)

42265 FUEL ELEMENT FOR NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,289,264. Feb. 19, 1962. Priority date May 17, 1960, Great Britain.

Fuel elements with helical fins, the sense of the helices being inverted at regular distances along the length of the element, are described. The stability of the element during operation is thus increased. (NPO)

42266 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,289,365. Feb. 19, 1962. Priority date May 24, 1960, Great Britain.

The manufacture of fuel rod cans having helical fins and longitudinal splitters is reported. The splitters are formed by extrusion on a cylindrical member extruded therewith, followed by cutting away the greater part of said member between the splitters to leave braces between them at intervals therealong. The extrusion is so performed that the splitters have portions that project radially inwardly between the braces. The integral splitter body is then slipped into a helically finned can, the inward projections engaging longitudinal slots that are cut in the helices. Finally the braces are deformed into transversal grooves in the helical fins. (NPO)

42267 MOUNTING OF A CONTAINER FOR PRESSURIZED GAS. (to Aktiebolaget Atomenergi). French Patent 1,290,450. Mar. 5, 1962. Priority date Apr. 22, 1960, Sweden.

The container is mounted in an excavated pressure resistant chamber in a rock formation (or concrete structure). The space between the container surface and the rock chamber wall is filled with a liquid that is in communication with the pressurized gas within the container. Preferably the container has at its top a bottle-neck-shaped opening surrounded by a cover open at the bottom, so that an annular interspace is formed between the outer surface of the bottle-neck and the cylindrical portion of the cover. This interspace forms the communication between the container and the liquid having a free level in the annular interspace. (IIB)

42268 IMPROVEMENTS RELATING TO DEVICES AND PROCESSES FOR THE DETECTION OF LEAKS IN NUCLEAR REACTORS. (to General Nuclear Engineering Corp.). French Patent 1,291,124. Mar. 12, 1962. Priority date May 2, 1960, United States.

A process for detecting burst slugs in nuclear reactors consists in increasing successively the specific power developed in the different fuel zones, so that the increasing of the power of that fuel zone which encloses the damaged fuel element provokes an increased leakage of fission products into the coolant followed by a rise of its activity that can easily be measured. Means operating according to this process preferably comprises a vertical channel within each zone wherein balls containing a poison are placed. For increasing the specific power in a given zone these balls are blown out by a jet of cooling fluid into a storage tube placed outside the reactor core as an upper extension of that vertical channel. (IIB)

42269 NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority. French Patent 1,291,294. Mar. 21, 1962. Priority date June 7, 1960, Great Britian.

An arrangement for measuring the temperature in an inner specimen of a vertical column of fuel elements that rest on each other in a reactor channel by means of cups and cones is described. The specimen is provided with a thermocouple, the leads of which are connected with two electrical contacts in the upper cup. The cups and cones of the higher fuel elements are also each provided with two electrical contacts, the contacts of adjacent elements touching each other while the contacts at the extremities of a same element are two and two connected by electrical cables. Thus an electrical connection between the thermocouple and the top cup of the column is realized. The connection leading to the outside of the coolant channel is effected by means of a telescopic member that is placed on top of the column and that is provided with sliding contacts that contact fixed contacts in the channel wall. (NPO)

42270 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,291,351. Mar. 12, 1962. Priority date June 9, 1960, Great Britain.

The canning of a fuel rod is provided with transversally undulated, longitudinal fins, some of which have a greater radial extension than the others. (NPO)

42271 IMPROVEMENTS IN HEAT EXCHANGERS. (to Commissariat a l'Energie Atomique). French Patent 1,291,702. Mar. 19, 1962. Filed Mar. 16, 1961.

Tubular heat exchange surfaces, notably fuel rod cans, that are provided with separated longitudinal zones of parallel fins that are inclined to the direction of the coolant flow, the inclination being opposite in adjacent zones were developed. Each fin is incurved at its extremities in the direction of the coolant flow in order to improve the latter. (NPO)

42272 PRESSURE VESSEL ESPECIALLY FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,292,073. Mar. 19, 1962. Priority date June 14, 1960, Great Britain.

A pressure vessel especially for nuclear reactors comprises within the vessel a first skirt mounted at its lower extremity on the bottom of the vessel wall and is fixed at its upper extremity to a second skirt coaxially disposed within the first one. A supporting bottom for the reactor core is mounted transversely to the second skirt near its lower extremity. The pressure vessel itself is mounted on a supporting skirt forming an outer extension of said first inner skirt. (IIB)

42273 NUCLEAR REACTOR SUPPLYING SUPERHEATED STEAM. A. Huet. French Patent 1,292,317. Mar. 26, 1962. Filed Mar. 22, 1961.

A design is given in which cylindrical channels are provided with supplementary fuel for superheating the steam supplied by centrifugal separating means. Preferably the supplementary fuel is disposed within the channel in the form of a hollow cylinder while a tubular thermal insulating wall subdivides the annular interspace between the hollow fuel cylinder and the main fuel elements into a marginal region, where the steam is separated from the boiling liquid being in heat exchanging relationship with the main fuel elements, and into an inner region, through which the steam flows down in contact with the outside of the fuel cylinder, before it passes through the inside of the cylinder in order to leave the reactor at the top. (IIB)

42274 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,292,866. Mar. 26, 1962. Priority date June 27, 1960, Great Britain.

Fuel rods, the cans of which are provided with helical fins and four longitudinal splitters that have a greater radial depth than the fins, are described. In order to prevent rattling of the fuel element during operation, it is proposed that: one of the splitters is undulated; one of the splitters gets a rough surface; one of the splitters is provided with a T-shaped edge; and three of the splitters have a reduced radial depth over the greater part of their length. (NPO)

42275 NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,293,880. Apr. 9, 1962. Priority date July 1, 1960, Great Britain.

The moderator structure of a nuclear reactor comprises a plurality of adjacent columns each composed of a series of moderator blocks disposed one above another. The blocks of the same column are individually supported by common supporting rods suspended on a construction at the reactor top and passing through vertical holes within the column. Preferably the rod has a cross section decreasing downwards and is provided with pieces for supporting the blocks. Adjacent blocks of adjacent columns are mutually connected by a system of keys and keyways, while the lower extremity of each column is centered by lugs or nozzles fixed on a base plate and fitting in corresponding holes of the columns, such as the lower extremity of the vertical reactor channel of that column. (IIB)

42276 IMPROVEMENTS RELATING TO FLUID TIGHT MEANS FOR THE CONNECTION OF DIFFERENT STRUCTURES, ESPECIALLY FOR THE CONTROL ROD DRIVES OF A NUCLEAR REACTOR. (to Commissariat a l'Energie Atomique). French Patent 1,294,194. Apr. 16, 1962. Filed Apr. 10, 1961.

Improvements are given that relate to connection means between two structures undergoing slight relative displacements especially between the pressure vessel of a nuclear reactor and the biological shielding enclosing this vessel so that these means may form a sliding chute for a control rod. The means comprise an inner tube suspended at its upper end by a ball-and-socket joint to the lower end of a shielding plug disposed within a cavity of the biological shielding and having a tortuous channel for the passage of the cable onto which the control rod is suspended. The lower end fits into a hole of the pressure vessel wall so as to allow slight deviations of this tube from the normal position, while an outer thin walled casing is connected at its extremities in a fluid tight manner with the hole in the vessel wall and the top of the shielding plug, respectively. The lower part of the container is adapted to bend in order to follow the relative displacement of the shielding and the vessel. (IIB)

42277 HETEROGENEOUS NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,294,664. Apr. 16, 1962. Priority date July 15, 1960, Great Britain.

A heterogeneous reactor especially a boiling water reactor comprises a heat transfer medium flowing in a circuit closed within the reactor vessel, the circuit comprises pairs of vertical tubes enclosing the fuel elements and being connected together by a U bend while the reactor coolant flows in upwards direction between the tubes. Means are provided to increase the heat exchange from the heat transfer medium to the coolant, when the former flows in a direction opposite to the coolant flow, and to decrease the exchange when it flows in the same direction as the coolant. Preferably this means comprises cooling fins on the tubes for increasing the heat exchange and a thermal isolation liner within the tubes in order to decrease it. Suitably several of the tube pairs are connected in series between a common entrance header and two exit headers of semicircular shape, while two pumps are provided to circulate the heat transfer medium from the exit headers to the entrance header. Preferably the whole of the tube pairs is enclosed within the reactor vessel by a dividing wall open at its ends in order to improve the natural circulation of the reactor coolant. (IIB)

42278 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,294,665. Apr. 16, 1962. Priority date July 29, 1960, Great Britain.

Rod shaped fuel elements, the sheath and the end caps of which have very thin walls 0.4 mm thickness, were developed. Both the sheath ends and the end caps are slightly conical, 0.005 cm/cm, so that the caps can be mechanically fastened in the sheath prior to welding. Preferably, two spaced welds are applied. The invention is illustrated with a fuel rod, consisting of a column of UO_2 pellets in a thin stainless steel can. The pellets are chamfered and their end surfaces slightly concave. Thus it is possible to press the can in the grooves that are formed by the chamfered edges while the adjacent concavities permit a certain axial dilation of the fuel. (NPO)

42279 HETEROGENEOUS NUCLEAR REACTORS. (to General Electric Co. Ltd.). French Patent 1,296,252. May 7, 1962. Priority date Aug. 19, 1960.

A heterogeneous nuclear reactor has its fissile material distributed in one or more two-dimensional lattices, each with a constant pitch. The flux flattening within the reactor core is controlled by plugs of moderating material within a number of channels instead of fissile material. Each of these plugs forms the center of a group of channels with fissile material so that almost all the lattice is composed of a number of such groups. The variation of the flux flattening is controlled by controlling the under-moderation by replacing the plugs by fissile material. (IIB)

42280 FUEL ELEMENTS FOR NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,296,865. May 14, 1962. Priority date Aug. 4, 1960, Great Britain.

A tubular sheath and an end cap are joined by means of a U-shaped weld at their common circumference. An apparatus for applying the weld is described. (NPO)

42281 IMPROVEMENTS RELATING TO HETEROGENEOUS NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,297,266. May 21, 1962. Filed May 17, 1961.

A heterogeneous nuclear reactor is comprised of more than one set of parallel reactor channels, each set forming a two-dimensional lattice while channels of different sets pass through the reactor core in different directions where they intercross, but not intersect. This arrangement has special advantages for gas-cooled heavy-water reactors, e.g., an increase of the distance between adjacent channels in the core, so that the arrangement of the fluid connection means may be simplified. The higher fuel concentration in the center of the reactor may lead to a higher average specific power in the reactor. (IIB)

42282 INSTALLATION WITH A NUCLEAR REACTOR COOLED BY A BOILING LIQUID AND PROCESS FOR THE OPERATION OF SUCH AN INSTALLATION. (to Babcock

and Wilcox Co.). French Patent 1,298,020. May 28, 1962. Priority date July 12, 1960, United States.

An installation with a nuclear reactor through which a boiling liquid circulates comprises a vapor separating device into which enters the vapor-liquid mixture leaving the reactor. The separated vapor is led to the place of its utilization, while the separated liquid is refed to the reactor. A design is given in which the latter liquid flows through two parallelly connected branches of the primary circuit before it enters the reactor; the first branch comprising heat exchange means, while the second one forms a bypass. Each of the branches is provided with means for controlling the relative liquid flow quantities in them in order to regulate the temperature of the liquid to be fed to the reactor. (IIB)

42283 IMPROVEMENTS RELATING TO PRESSURE TUBE REACTORS. (to General Nuclear Engineering Corp.). French Patent 1,299,368. June 12, 1962. Priority date Sept. 7, 1960, United States.

The pressure tubes of a nuclear reactor disposed in a series of parallel planes are grouped into different sets of parallel tubes that are disposed in a series of parallel planes so that the tubes of the same set occupy at most two adjacent planes. The tubes of adjacent groups form between them an angle sufficient to ensure that the tubes of different groups pass through the wall of the reactor container at different zones of it where the coolant headers for the tubes are disposed. In this way there is more place for the header construction than in the usual disposition of the pressure tubes. (IIB)

42284 HEAT EXCHANGE SURFACES FOR FUEL ELEMENT CANS. (to United Kingdom Atomic Energy Authority). French Patent 1,300,486. June 25, 1962. Priority date Sept. 14, 1960, Great Britain.

A cylindrical can is provided with an even number of longitudinal zones of helical fins, the sense of the helices in adjacent zones being opposite. Longitudinal splitters are fitted at the places of junction of the zones, the splitters acting as anti-bending spacers when the fuel element is placed in a coolant channel. (NPO)

42285 STORAGE OF SPENT FUEL ELEMENTS. (to Brown, Boverie and Cie). French Patent 1,301,079. July 2, 1961. Priority date Nov. 30, 1960, Germany.

Spent fuel elements, such as spent fuel spheres, are stored, cooled down, and then shipped in a container that is filled with an organic substance having a melting point of 20–40°C, such as diphenyl or paraffin, and is provided with a rack to keep the fuel elements at a minimum distance from bottom and walls. (NPO)

42286 METHOD AND DEVICE FOR CONTROLLING THE REACTIVITY IN SUBCRITICAL STATE. (to Commissariat a l'Energie Atomique). French Patent 1,303,489. Aug. 6, 1962. Filed June 22, 1961.

The excess reactivity of a nuclear reactor in sub-critical state is determined by placing a neutron source into the reactor and measuring the neutron flux by an appropriate detector. The flux is a function of the excess-reactivity and is proportional to the intensity of the source. In order to compensate the diminution of the source intensity with the time, a reference voltage is produced with the aid of a potentiometric device that is graduated in time. The reference voltage is compared with the output voltage of the detector and is initially adjusted to its original value. The reference voltage is decreased by switching of the potentiometric device, according to the same exponential function as the function indicating the decrease of the intensity of the source. A warning signal is produced if the output voltage of the detector increases the reference signal. (IIB)

42287 CHARGING DEVICE FOR NUCLEAR REACTORS. (to Sulzer Freres S. A.). French Patent 1,304,797. Aug. 20, 1962. Priority date Dec. 12, 1960, Switzerland.

A charging device for pressure-tube reactors is described. The coolant connections are disposed at the upper extremities of the vertical pressure tubes, while the charging and discharging of the fuel elements into and from the tubes are performed from the bottom of the reactor core. This charging device comprises lifting means adapted to move the elements into and from the pressure tubes, while coupling means are provided to connect the lifting means with the lower extremity of the fuel element, so that the coupling is always locked unless in the uppermost position of the lifting device. The drive mechanism for the device is mounted at a bottom cover piece of the device so that this mechanism can easily be removed from below. The casing of the device is filled with a cooling liquid, suitably water, to ensure the cooling of a fuel element during its transfer. The device is mounted on a gantry and can be tilted out from its vertical direction for transferring fuel elements from and to the charging device. (IIB)

42288 IMPROVEMENTS RELATING TO PLUGS WITH LOCKING MEANS FOR NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,305,509. Aug. 27, 1962. Filed Aug. 16, 1961.

In order to fix a closure plug in the extremity of a reactor channel a series of levers is pivotally mounted in the plug's body, each lever being adapted to rotate about an axis parallel to the plug's axis. In one of its end positions it may engage into an annular groove in the channel wall, while in the second end position the plug is free to be removed. A handling tool for removing the plug comprises an outer tube, the extremity of which joins the channel end-nozzle, an inner tube adapted to move axially in this outer tube and sliding within the inner tube, a handling rod adapted to connect via a bayonet-coupling with a locking rod in the plug. This locking rod is normally locked in one of its positions by a further system of levers pivotally mounted in the plug's body. The unlocking of this rod is performed by thrusting the inner tube of the handling tool against a number of levers of the system, after which the handling rod coupled with the locking rod may be axially moved in order to control the movement of the levers engaging in the channel wall. Each axle of these levers is provided with two notches, one of which cooperates with the locking rod for the control of the rotation of the axle, while the other one serves to engage in a groove machined in the inner wall of the inner tube of the handling tool, so that a rotation of said axles between the two end positions simultaneously corresponds to the decoupling of the plug from the channel and its coupling with the handling tool and vice versa. (IIB)

42289 IMPROVEMENTS RELATING TO DEVICES FOR FIXING AND REMOVING CLOSURE PLUGS OF REACTOR CHANNELS. (to Commissariat a l'Energie Atomique). French Patent 1,305,511. Aug. 27, 1962. Filed Aug. 16, 1961.

In order to fix a closure plug in the end of a reactor channel a series of levers is pivotally mounted in the plug's body. These levers are provided with lugs adapted to engage in a first end position into a groove in the channel wall, while in the second end position the plug is free to be removed. The handling tool for removing the plug com-

prises a tube, the end of which joins the channel end-nozzle and a grip comprising a head in which are pivotally mounted a series of levers, each provided with inner and outer lugs. Each of these grip levers is movable between two end positions by the action of the movement of a rod adapted to slide axially within the grip. The inner lugs serve to engage with a piece axially slidable within the plug's body between a first position locking the plug's levers in their engagements with the wall and a second position wherein the plug's levers are free to be moved by the action of the outer lug of the levers of the grip, thus engaging at the same time with a shoulder of the plug, such as to couple with it. The plug can then be withdrawn into the tube of the handling device. (IIB)

42290 NUCLEAR REACTOR MODERATED WITH A VAPORIZABLE LIQUID AND A SUPERHEATING DEVICE FOR THE PRODUCED VAPOR. (to Brown, Boveri & Cie AG and Beteiligungs- und Patentverwaltungs GmbH). French Patent 1,305,694. Aug. 27, 1962. Priority date Oct. 29, 1960, Germany.

In order to prevent complicated circuits within boiling liquid reactors with nuclear superheating, the reactor is subdivided in a lower region filled with a vaporizable liquid moderator into which are dipped the lower portions of vertical fuel elements, and into an upper region comprising a solid moderator. The vapor formed in the lower region rises and passes through the upper region where it is superheated. According to one embodiment the superheating is due to the heat developed in the upper portions of the fuel elements. Due to the poor cooling capacity of the vapor the temperature of upper fuel regions rises to an extent so as to guarantee the necessary heat removal and superheating temperature, in this embodiment the moderator being formed by hollow cylinders enclosing the upper fuel element portions. According to another embodiment the fuel in the upper reactor region is disposed in the shape of hollow cylinders forming liners in vertical channels of a solid moderator block. (IIB)

42291 BOILING WATER REACTORS. (to Vickers Armstrongs (Engineers) Ltd.). French Patent 1,306,977. Sept. 10, 1962. Priority date Nov. 25, 1960, Great Britain.

In a boiling water reactor working with light or heavy water, or with a mixture of both, a special steam cycle is made use of by which a portion of the steam taken from the top of the vessel is reinjected at the bottom of the reactor vessel. In this way the steam quantity is independent of the produced power. Preferably the steam coming from the reactor is circulated by a pump to a distribution valve controlling the rate of reinjected steam in function of the steam demand. The reinjection line connecting this distribution valve with the bottom of the reactor can be bypassed by a valve the opening of which depends on the steam working pressure to provoke an increased reinjection when the working pressure increases in order to reduce the steam production and vice-versa. Shim rods are provided for compensating the long term reactivity losses due to the fuel burn-up. (IIB)

42292 THERMAL NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,307,134. Sept. 10, 1962. Priority date Nov. 30, 1960, Great Britain.

In order to avoid thermal stresses of metal plates due to the difference of thermal expansions especially during thermal transients, a design is given to ensure the free expansion of the plates with respect to the framework. These means comprise keys fixed on the framework and adapted to slide in keyways provided in marginal regions of the plates, the planes of symmetry of the keys passing through the center of the plates. The plates have holes corresponding to the reactor channels, the graphite blocks of the lowest layer are fixed to said plates, so as to maintain the alignment of holes with their corresponding channels. (IIB)

42293 THERMAL NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,308,258. Sept. 24,1962. Priority date Dec. 16, 1960, Great Britain.

A design is given whereby metallic plates are fixed with respect to the moderator structure so as to allow differences in expansion between the structure and the plates. Each plate is positively fixed to at least one adjacent block while adjacent plates, forming interspaces between them, are mutually connected by keys sliding in keyways machined in the sidefaces of the plates, the symmetry plane of each key way passing through the center of the corresponding plate. (IIB)

42294 BOILING LIQUID REACTOR WITH INCORPORATED STEAM SEPARATING AND SUPERHEATING INSTALLATION. (to Babcock and Wilcox Co.). French Patent 1,310,819. Oct. 22, 1962. Priority date Dec. 1, 1960, United States.

A boiling liquid reactor design comprises a series of parallelly arranged fuel element assemblies, each of them comprising two fluid flow paths. One of the paths is in heat exchanging relationship with one portion of the fuel element surface, the second one with another portion of the latter. The boiling liquid leaving the first flow path enters into a steam separating device from where the separated steam enters into the second flow path in order to become superheated. Preferably the fuel assemblies comprise parallel fuel tubes extending over its whole length. The space between the tubes forms the first flow path, while the whole of the central channels within the tubes forms the second flow path. The flow in the first path goes from the bottom to the top of the assembly, while the flow in the second, the superheating path, goes in the opposite direction. (IIB)

42295 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to General Dynamics Corp.). French Patent 1,310,838. Oct. 22, 1962. Priority date Dec. 7, 1960, United States.

A gas cooled nuclear reactor comprises a reactor core within a pressure vessel and lower and upper reflector portions, respectively, spaced from the lower and upper ends of the vertically arranged fuel elements. The cooling gas enters the reactor near the vessel bottom via several ducts, rises within the interspace between the vessel wall and a lateral reflector portion surrounding the core, flows downwards from the space above the core top in heat exchanging relationship with the fuel elements, and finally leaves the reactor over lower exit header spaces and exit ducts, the latter suitably concentrically disposed within the entrance ducts. According to a preferred embodiment the core is subdivided by a series of dividing walls so as to form a lattice of parallel reactor channels of rectangular cross section in which the fuel elements are disposed. The fissile material within the fuel elements is mixed with a solid moderator so as to avoid the necessity of cladding. Preferably the fuel elements are suspended on a support structure above the reactor top. (IIB)

42296 IMPROVEMENTS RELATING TO REACTORS WORKING WITH A BOILING COOLANT, ESPECIALLY WITH BOILING WATER. (to General Nuclear Engineering Corp.). French Patent 1,310,876. Oct. 22, 1962. Priority date Dec. 20, 1960, United States.

A nuclear reactor cooled by a boiling liquid has several vertically disposed regions separated from each other with respect to the coolant flow, the coolant flowing in each region from the bottom to the top. The regions are connected in series so that the liquid phase of the coolant passes first the regions with the highest power density and then successively the other regions in the sequence of decreasing power density. Each region is succeeded by means for separating the vapor from the liquid that is afterwards introduced to the following region. Liquid circulation is maintained by a pump at the entrance of the central region. (IIB)

42297 PROP FOR THE LATERAL SUPPORT STRUCTURE OF THE SOLID MODERATOR SYSTEM OF A NUCLEAR REACTOR. (to Commissariat a l'Energie Atomique). French Patent 1,311,360. Oct. 29, 1962. Filed Oct. 26, 1961.

Solid moderator systems comprising adjacent columns of graphite blocks mutually connected by means of keys and keyways are provided with lateral support structures, e.g., comprising a series of props fixed at their ends in the core supporting structure. An improved prop, adapted to follow bends of the lateral moderator columns that may arise during the reactor operation, comprises a rigid core-rod about which a series of hollow metallic prisms are disposed one above the other with a small interspace between them. The interspaces show an inclination with respect to the axis of the prop. Each prism is supported by the rigid core by centering rings, such as to conserve an annular interspace between the core and the bore of the prism for the circulation of a cooling fluid. (IIB)

42298 PRESSURE VESSEL ESPECIALLY FOR NUCLEAR REACTORS. (to Simon Carves Ltd. and General Electric Co. Ltd.). French Patent 1,311,425. Oct. 29, 1962. Priority date Nov. 8, 1960, Great Britain.

A prestressed concrete pressure vessel has a cylindrical shape and is closed at the bottom and the top by vaulted portions having an inner convex surface. A fluid tight liner is provided within the vessel enclosing the reactor core. A portion of the liner is spaced from the inner surface of the vessel, the interspaces formed in this manner being filled with an inert material serving only for the transmission of pressure from the liner to the pressure vessel wall. Preferably the interspaces are disposed at the bottom and the top and have suitably a double-concave or plane-concave lenticular shape, such as to allow plane or convex bottom or top surfaces of the liner, while vertical ducts may pass the interspaces giving access to the reactor core. (IIB)

42299 IMPROVEMENT IN FUEL ELEMENTS FOR NUCLEAR REACTORS. (to C. A. Parsons and Co. Ltd.). French Patent 1,312,093. Nov. 5, 1962. Priority date Nov. 21, 1960, Great Britain.

Assemblies of a limited number of fuel rods that are each provided with helical fins and longitudinal splitters, the splitters being arranged so that the coolant channel is subdivided into a number of sub-channels, are described. Various embodiments are given in which the assembly is supported by a carrier frame or tube. (NPO)

42300 FUEL ELEMENT FOR NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,312,824. Nov. 12, 1962. Priority date Feb. 1, 1961, Great Britain.

Hollow fuel rods are reinforced by means of a tubular socket in the interior cavity on which the two halves of the fuel core are fastened. (NPO)

42301 NEW CONTROL ROD TYPE FOR NUCLEAR REACTORS. (to U. S. Atomic Energy Commission). French Patent 1,313,033. Nov. 12, 1962. Priority date Feb. 6, 1961, United States.

In order to avoid gas pressure within fuel rods, a process of fabrication of a rod containing nuclear material is proposed consisting in placing a quantity of the material in powder form into a tube and in inserting porous plugs in the open extremities of the tube, in squeezing the plugs and the material applying of pressure at the two plug ends, and finally in decreasing the diameter of the tube by cold or hot drawing or suitably by cold swaging. Preferably the porous plugs are constituted of compressed metal wool having a density of 30-50% of that of the massive metal. After compressing by this process, the density of the plugs is increased to about 95%, at which density the plugs are impermeable to liquid but fairly permeable to the gas developed within the rod. (IIB)

42302 FUEL ELEMENT CELL FOR NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,313,196. Nov. 19, 1962. Filed Nov. 13, 1961.

Fuel rod assemblies in pressure tubes are considered. In order to achieve flux flattening the rods are either placed in an annular, peripheral zone of the tube, the central zone being left empty, or the rods are placed in both zones, in both cases the peripheral zone being used for vaporization of the coolant and the central zone for superheating the vapor. In a special embodiment the central rods do not occupy the full height of the zone. (NPO)

42303 FUEL ELEMENTS. (to United Kingdom Atomic Energy Authority). French Patent 1,313,368. Nov. 19, 1962. Priority date Dec. 16, 1960, Great Britain.

The manufacture of canned fuel plates that are provided with a thermocouple is described. The fuel elements are made according to the picture-frame method, the core being provided with a longitudinal slit in which a wire, lubricated with graphite, is stuck. After each pass through the rolling mill the wire is replaced by a thinner one and finally by a thermocouple that is roll-bonded in the last pass. (NPO)

42304 IMPROVEMENTS RELATING TO STRUCTURES OF SOLID MODERATOR BLOCKS FOR NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,313,894. Nov. 26, 1962. Filed Nov. 20, 1961.

In order to increase the strength of moderator blocks and to economize material the blocks are machined starting from a cylindrical rod. The rod has a diameter slightly smaller than that of the cylinder passing through the longitudinal edges of the virtual prism that would form with similar ones a lattice without interspaces having the desired pitch. The bottom of the groove has the same distance from the block center as the base of the rib. According to a first embodiment the side faces of the blocks have a concave or convex surface depending on whether they are provided with ribs or with grooves, respectively. According to another embodiment the side faces are mainly plane and are either provided with two shallow grooves at both sides of a rib or with two low ribs at both sides of a groove. (IIB)

42305 MODE AND DEVICE FOR CONTROLLING A NUCLEAR REACTOR. (to Babcock and Wilcox Co.). French Patent 1,317,497. Jan. 2, 1963. Priority date Feb. 28, 1961, United States.

A method is given for the displacement of neutron absorbing material in nuclear reactors within ducts by the action of a fluid flowing through said ducts, so that according to the intensity and direction of that flow the absorbing material comes to rest within the reactor core re-

gion or is blown out from that region. Preferably the ducts are vertical, each having a lower region occupying the whole height of the reactor core, and an upper region of the core, while the absorbing material consists of a series of absorbing balls of a diameter slightly smaller than the duct's diameter. For controlling the fluid flow, the lower end of each duct is preferably in communication with the upstream side of the reactor coolant circuit, whie the upper end is brought in communication either with the downstream side of that circuit, or with an appropriate fluid pressure higher than the pressure in the downstream side. (IIB)

42306 GAS-COOLED NUCLEAR REACTOR WHICH IS TO BE FUELLED WHILE UNDER LOAD, AND IN WHICH FUEL CHANNELS ARE PROVIDED WITH COOLANT FLOW RESTRICTOR MEMBERS. James Simon Picton (to Babcock and Wilcox Ltd.). German Patent 1,151,326. July 11, 1963. Priority date Apr. 1, 1960, Great Britain.

A gas-cooled nuclear reactor is described that is to be refueled while under load and has upright fuel channels arranged for upward flow of coolant and upward withdrawal of fuel elements. The fuel channels are provided with movable coolant flow restrictor members each of which is normally maintained in an inoperative position. A minimum of restriction is effected on the coolant flow by a force due to gravity acting upon a fuel element in the associated fuel channel. The element being lifted is moved by differential pressure thereon of the coolant flowing through the channel to a restricting position in which it serves to limit the rate of coolant flow through the channel. (Gmelin Inst.)

42307 NUCLEAR REACTORS. Alan Howard Cottrell and Michael Warwick Thompson (to United Kingdom Atomic Energy Authority). U. S. Patent 3,105,804. Oct. 1, 1963. Priority date July 15, 1958, Great Britain.

A means is described for avoiding Wigner energy release in a graphite-moderated reactor by ensuring that the graphite temperature remains high enough that Wigner energy cannot be stored. This higher temperature is achieved by running the coolant through annular sleeves within the coolant channels, such that the coolant is separated from the moderator by the sleeves. The sleeves impede heat transfer from moderator to coolant, so that the graphite temperature at a given point is always somewhat higher than that of the coolant. (T.F.H.)

42308 NUCLEAR REACTOR MODERATOR STRUCTURES. William Rodwell (to United Kingdom Atomic Energy Authority). U. S. Patent 3,105,805. Oct. 1, 1963. Priority date July 1, 1957, Great Britain.

A resilient support for the moderator and reflector of a reactor that is mounted on a moving vehicle (e.g., a ship) is described. The support consists of a group of shoes, bearing on the moderator and pivoted on a circle concentric with the moderator. The shoes are spring-loaded to press against the moderator, and adjacent shoes are coupled by springs under tension. (T.F.H.)

42309 FUEL ELEMENTS FOR NUCLEAR REACTORS. Leslie Reginald Blake (to United Kingdom Atomic Energy Authority). U. S. Patent 3,105,807. Oct. 1, 1963. Priority date Jan. 12, 1959, Great Britain.

A method is described for sheathing a rectangular fuel plate so that the advantages of thin sheathing are not offset by the disadvantage of radiation swelling of thinly sheathed fuel. The sheath consists of a thin metallic cover that leaves space around the edges to accomodate transverse swelling of the fuel within. The sheath may be ribbed on one or both sides to provide separation of adjacent elements. (T.F.H.)

42310 SHELL FOR FLUID-COOLED REACTORS. Andrew L. Lawson and Joseph J. Maurin (to Chicago Bridge and Iron Co.). U. S. Patent 3,105,808. Oct. 1, 1963. Filed Aug. 1, 1960.

A reactor vessel is described that employs a laminated construction in order to achieve high strength. This laminated construction, however, impedes the heat generated in the vessel (by neutrons, gammas, fission products, etc.) from returning into the coolant fluid. A solid construction, which has a higher heat transfer coefficient, is therefore used in the vessel in the section near the reactor core. The vessel is cylindrical, with rounded ends. The reactor core is thus situated such that it is nearest the middle of the cylinder. The solid construction comprises about half the total thickness of the vessel, and the solid and laminated sections are joined together in a stepwise fashion. (T.F.H.)

42311 REACTOR CONTROL ROD DRIVE MEANS. Herbert A. Schwan and Harold A. Thomas (to General Dynamics Corp.). U. S. Patent 3,106,519. Oct. 8, 1963. Filed July 28, 1959.

An electric device is described for automatically and remotely positioning and adjusting the (vertical) control rods in a reactor. The device is also capable of quickly dropping the rods by de-energizing an electromagnet that connects the rod to the lifting cable. (T.F.H.)

42312 CONCENTRIC TUBE STRUCTURE. William A. Wolfe and Liberty Pease (to Atomic Energy of Canada Ltd.). U. S. Patent 3,106,520. Oct. 8, 1963. Filed Feb. 9, 1961.

A spacer is described that is designed to separate the calandria tube from the pressure tube of a reactor. The spacer consists of an endless helical coil wrapped around the inner vessel. The coil is not connected to either the inner or outer tube, so that relative axial movement of the tubes is allowed. (T.F.H.)

42313 CONTROL ROD COUPLING FOR NUCLEAR REACTORS. Erling Frisch (to Westinghouse Electric Corp.). U. S. Patent 3,107,209. Oct. 15, 1963. Filed Jan. 23, 1957.

A remotely operable control rod coupling assembly is presented. The control rod has a cruciform cross sectional configuration with shouldered indents formed in the end. The driving shaft terminates in a hollow cylindrical body with radial slots corresponding to the arms of the control rod. A latching lever is pivotally mounted in each of the slots. (C.E.S.)

42314 CORE-SAMPLING APPLIANCE FOR GRAPHITE-TYPE NUCLEAR REACTOR. Roger Cante (to Commissariat a l'Energie Atomique). U. S. Patent 3,107,740. Oct. 22, 1963. Priority date May 30, 1959, France.

A device for removing graphite samples from the internal walls of the ducts in the stacks of a nuclear reactor is described. The samples may be cut out without impairing the properties of the graphite and without raising the temperature of the graphite during cutting. The apparatus consists of an elongated element insertable in the bore, an end-cut cutting tool tapered toward its base mounted on the elongated element and rotatable, a motor outside the bore for driving the tool, power lines connecting the motor and tool, a tool base, a forward feed for moving the tool along its axis, and means for the core sample to be broken off at its base when cutting is finished. (M.C.G.)

42315 METHOD FOR INHIBITING REACTION BETWEEN CARBON DIOXIDE AND GRAPHITE IN A HETEROGENEOUS NUCLEAR REACTOR. Olle Lindstrom (to Allmanna Svenska Elektriska Aktiebolaget). U. S. Patent 3,108,051. Oct. 22, 1963. Priority date Nov. 19, 1959, Sweden.

A method is described for inhibiting reactions of CO_2 with carbon in a reactor. It consists of adding hydrogen gas continuously to the CO_2 before passing it over the graphite and of continuously removing water vapor formed in the reactor in an auxiliary circuit between the reactor and heat exchanger. (M.C.G.)

42316 NUCLEAR REACTOR SHIELD. Anthony Stathoplos and Lawrence A. Wills (to United Nuclear Corp.). U. S. Patent 3,108,052. Oct. 22, 1963. Filed Nov. 3, 1955.

A method for constructing radiation shields for reactors so that the reactor and shield assembly have a low weight is described. The reactor is assumed to have a core of fissionable material in which the fission process utilizes predominantly neutrons with a median energy of the order of 10^5 ev. The shield has a first layer of high-density material adjacent ot the reactor core for gamma attenuation and a second layer of material of low atomic mass for neutron attenuation and absorption. (M.C.G.)

42317 HEAT TRANSFER SYSTEMS FOR NUCLEAR REACTORS. Bernard Vrillon and Roland Roche (to Commissariat a l'Energie Atomique). U. S. Patent 3,108,053. Oct. 22, 1963. Priority date June 4, 1959, France.

Heat transfer systems for gas-cooled heavy-water-moderated reactors for reduction of the detrimental effects of thermal expansion are described. The tubular header elements and the portions of the heat-transfer channels leading to the headers are arranged so that the headers are kept at low temperature by the combined action of an internal heat insulation and of an external cooling. The internal heat insulation is obtained in the form of a layer of insulating gas interposed between every tubular element and an internal sheath concentric thereto, so as to form a jacket. For external cooling there is a circulation of air or gas along the system formed by channel heads and header tubular elements, which may be provided with cooling fins. (M.C.G.)

42318 *NUCLEAR REACTOR COOLANTS.* Hendricus M. Penning and Martinus Kolijn (to Shell Oil Co.). U. S. Patent 3,108,935. Oct. 29, 1963. Priority date Sept. 5, 1958, Netherlands.

The cooling of nuclear reactors by aromatic hydrocarbons is discussed. The aromatic hydrocarbon fraction obtained by extraction of a catalytically cracked cycle oil with no more than 0.5% sulfur by weight and boiling in the range of 300 to 500°C and refined by catalytic treatment with hydrogen was found to be stable to radiation. (M.C.G.)

42319 FUEL ELEMENT FOR NUCLEAR REACTOR. Richard H. Gale (to Combustion Engineering, Inc.). U. S. Patent 3,108,936. Oct. 29, 1963. Filed Oct. 28, 1959.

A fuel element, employing UC as fuel, that may be used in water-cooled reactors in comparative safety is described. The ceramic fuel is in slugs encased in protective fluid-tight coatings of magnesium zirconate or zirconium carbide. The slugs are placed in a fluid-tight jacket of a corrosion resistant metal. (M.C.G.)

42320 FUEL ELEMENT FOR A NUCLEAR REACTOR. John K. Davidson (to U. S. Atomic Energy Commission). U. S. Patent 3,111,475. Nov. 19, 1963.

A fuel element structure particularly useful in high temperature nuclear reactors is presented. Basically, the structure comprises two coaxial graphite sleeves integrally joined together by radial fins. Due to the high structural strength of graphite at high temperatures and the rigidity of this structure, nuclear fuel encased within the inner sleeve in contiguous relation therewith is supported and prevented from expanding radially at high temperatures. Thus, the necessity of relying on the usual cladding materials with relatively low temperature limitations for structural strength is removed. (AEC)

42321 FUEL ELEMENT. Raymond W. Bean (to U. S. Atomic Energy Commission). U. S. Patent 3,111,477. Nov. 19, 1963.

A ceramic fuel element for a nuclear reactor that has improved structural stability as well as improved cooling and fission product retention characteristics is presented. The fuel element includes a plurality of stacked hollow ceramic moderator blocks arranged along a tubular metallic shroud that encloses a series of axially apertured moderator cylinders spaced inwardly of the shroud. A plurality of ceramic nuclear fuel rods are arranged in the annular space between the shroud and cylinders of moderator and appropriate support means and means for directing gas coolant through the annular space are also provided. (AEC)

42322 METAL ALLOY SUITABLE FOR CONTROLLING THERMAL NEUTRON REACTORS. Robert J. Schier (to U. S. Atomic Energy Commission). U. S. Patent 3,112,196. Nov. 26, 1963.

A homogeneous arc-melted alloy suitable for nuclear reactor control material consisting essentially of titanium and up to about 6 wt % gadolinium as gadolinium oxide is described. (AEC)

Power Reactors

Refer also to abstracts 41092, 41093, 41094, 41095, 41102, 41103, 41104, 41119, and 41730.

42323 (ACNP-62573) COOLANT SYSTEM PIPING FAILURES—HAZARDS ANALYSIS. EXPERIMENTAL GAS COOLED REACTOR. R. L. Schlegel and A. DeAgazio (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Mar. 21, 1963. Contract AT(11-1)-654. 55p. (EGCR-Study-IV-303(Rev.1))

A study was made of credible failures in the EGCR coolant system piping and of the possible effects of these failures on the reactor and plant components. The locations and sizes of credible failures in the hot leg and cold leg piping, and the resulting maximum pressure differentials were calculated. It is concluded that no damage from the pressure differentials should result in the reactor core, vessel components, or steam generator and blower in the sound loop. However, some blower damage may occur due to possible surge of the blower. (D.L.C.)

42324 (ACNP-63017) PATHFINDER ATOMIC POWER PLANT. DESIGN AND OPERATION OF A BOILING AND SUPERHEATING HEAT TRANSFER LOOP. R. B. Jerman and Mark Healy (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Aug. 15, 1963. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 23p.

A test loop was designed and fabricated for the study of the heat transfer and fluid flow characteristics of boiler and superheater fuel elements at heat fluxes of 70,000 to 500,000 Btu/hr-ft^2. The design and operation of the loop are described. D-c resistance heating at low voltages was

used. Control, instrumentation, and shakedown tests are discussed. Runs performed to date are described. (D.L.C.)

42325 (AECL-1789) PAPERS PRESENTED BY ATOMIC ENERGY OF CANADA LIMITED AT THE CANADIAN NUCLEAR ASSOCIATION INTERNATIONAL CONFERENCE, MONTREAL, MAY 27–29, 1963. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 135p.

Six papers are included which treat the following topics: economics and technology, design and cost trends of D_2O-moderated nuclear power plants, NPD fuel performance, structural materials for power reactors, Canadian experience with reactor moderators and coolants, and industrial use of Co^{60}. Five of the papers were previously abstracted in NSA. (D.L.C.)

42326 (AECL-1807) THE NINTH AECL SYMPOSIUM ON ATOMIC POWER AT TORONTO, ONTARIO, SEPTEMBER 23, 1963. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 78p.

Eleven papers are presented that treat various topics in the Canadian nuclear power program and that discuss future plans and hopes. These topics include: NPD operation, Douglas Point, development of advanced D_2O reactors, and use of other coolants in D_2O reactors. Separate abstracts were prepared for all eleven papers. (D.L.C.)

42327 (AECL-1807(p.7-15)) EXPERIENCE IN OPERATING NPD. S. G. Horton (Ontario. Hydro-Electric Power Commission, Rolphton).

A review is presented of the operation of NPD from Oct. 1, 1962, to Sept. 3, 1963, with particular emphasis on the attained capacity factors and the reasons for lost production. Some of the technical problems are described. (D.L.C.)

42328 (AECL-1807(p.16-17)) DOUGLAS POINT: STATUS REPORT. J. S. Foster (Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto).

The status of the following aspects of the Douglas Point Reactor is outlined: engineering, purchasing, costs, manufacturing, and construction. (D.L.C.)

42329 (AECL-1807(p.18-24)) DOUGLAS POINT: CIVIL FEATURES. D. L. S. Bate (Ontario. Hydro-Electric Power Commission, Rolphton and Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto).

Descriptive diagrams and photographs are given of the site layout, reactor building, service building, turbine building, pumphouse, and intake structures. (D.L.C.)

42330 (AECL-1807(p.25-30)) DOUGLAS POINT: THE CANDU REACTOR. C. E. Beynon (Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto).

A diagram is given of the over-all arrangement of the reactor, and photographs are given of the various reactor components (calandria, end shields, dump tank, expansion joint) during manufacture. (D.L.C.)

42331 (AECL-1807(p.31-7)) DOUGLAS POINT: THE PRIMARY HEAT TRANSPORT SYSTEM. A. E. Hart (Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto).

Several diagrams and one photograph are presented to describe the following aspects of the primary heat transport system; feeders, headers, and pumps; flow; boilers; and cooling and seal arrangement for primary pump. (D.L.C.)

42332 (AECL-1807(p.38-44)) DOUGLAS POINT: THE TURBINE-GENERATOR PLANT. I. L. Smith and N. M. Thompson (Ontario. Hydro-Electric Power Commission, Rolphton and Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto).

Diagrams and photographs are given of the turbine cycle, station outline, layout of electrical equipment, turbine, generator, and turbine building. The characteristics of the turbine-generator and steam conditions are tabulated. (D.L.C.)

42333 (AECL-1807(p.45-52)) EXPERIMENTAL STUDIES AT CHALK RIVER ON ENGINEERING AND DESIGN PROBLEMS OF ADVANCED REACTOR SYSTEMS. W. A. Wolfe (Atomic Energy of Canada Ltd., Chalk River, Ont.).

Three of the possible ways to lower power costs in D_2O-moderated reactors are to use organic coolants, boiling D_2O coolant, and two-phase light water coolant (fog or boiling). The development work needed on each of these three ways and the test facilities being used in this development work are outlined. These facilities and some preliminary results are described in some detail. (D.L.C.)

42334 (AECL-1807(p.53-8)) ADVANCED D_2O-COOLED REACTORS. W. G. Morison (Ontario. Hydro-Electric Power Commission, Rolphton and Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto).

The following possible ways of reducing power costs from D_2O-cooled reactors are discussed: increased unit size, higher fuel rating, Zr–Nb alloy pressure tubes, reduced calandria-tube wall thickness, boiling D_2O coolant, increased reactor outlet temperature, axial flattening of neutron flux, reduced fuel fabrication costs, and improved design and construction. The estimated power cost from a 500-Mw(e) unit incorporating the above improvements is plotted. (D.L.C.)

42335 (AECL-1807(p.59-67)) LIGHT-WATER COOLED HEAVY-WATER-MODERATED NATURAL-URANIUM POWER REACTORS. G. A. Pon (Atomic Energy of Canada Ltd., Chalk River, Ont.).

Studies were carried out on the 450-Mw(e) design concepts of three light water-cooled reactors: fog, boiling, and once-through. Core optimization studies were made and the parameters of the selected cores tabulated. The research and development program for these reactors is described. The main feasibility problem is concerned with the heat-transfer and fluid-flow characteristics of two-phase mixtures of steam and water. (D.L.C.)

42336 (AECL-1807(p.68-73)) THE ORGANIC-COOLED HEAVY-WATER-MODERATED REACTOR SYSTEM. K. H. Campbell (Canadian General Electric Co., Ltd. Civilian Atomic Power Dept., Peterborough, Ont.).

Engineering studies of the OCDR concept indicate a UC-fuelled, organic-cooled power reactor to be the most technically efficient converter of uranium fuel to electrical energy of the concepts studied to date. This excellent conversion, coupled with the economic considerations indicates a potential of generating electrical energy at approximately 10% below the cost projected for the other reactor types. It is of interest to note that a similar study recently conducted by the USAEC on heavy-water-moderated reactors, also indicated organic coolant to have outstanding advantage over the other coolant means. This study however, like that for the other coolant types, is based upon the assumption of favourable results of development work. The major goals which must be successfully achieved are an adequate fuel-sheathing material, an economically attractive fuel-channel design, and a fuel design utilizing uranium carbide. While the development effort on the organic system and other advance concepts is underway, cost reductions will be taking place on the heavy-water-cooled and -moderated reactor, through both construction and operating experience. Both of the major Canadian design teams are using experience gained with the design and construc-

tion of NPD and Douglas Point, and have improvement development effort underway to help bring cheaper power from this reactor type. The CANDU reactor must at present be considered the forerunner in economic electrical power generation, due to its basic soundness and development maturity. However, the economic potential of the OCDR concept, coupled with the distinct possibility of near term solution of the development challenges, is such that organic-system development is amply justified. (auth)

42337 (AECL-1807(p.74-8)) POWER REACTOR EVALUATION AND OUR POSITION IN THE WORLD. W. B. Lewis (Atomic Energy of Canada Ltd., Chalk River, Ont.).

The power reactor position of Canada is discussed relative to the world, U. S. and U.K. in particular. The position is at the top, but the 2-year lead could be lost owing to the fact that the successor to CANDU probably will not be completed before 1969. Power cost estimates are given for several 450-Mw(e) D_2O power reactors using different coolants, and the reactors are compared. The long-term prospects of power reactors are next considered, and it is concluded that the future appears bright for D_2O reactors. (D.L.C.)

42338 (AECL-1844) CASTING AN EPOXY RESIN TO REPAIR A HEAVY-WATER LEAK IN THE NRU REACTOR. Norman E. Brown (Atomic Energy of Canada Ltd. Chalk River Nuclear Labs., Chalk River, Ont.). Oct. 1963. 13p. (CONF-243-4)

From American Nuclear Society Conference on Problems of Operating Research and Power Reactors, Ottawa, Oct. 1963.

In July 1962, the NRU reactor developed leaks in several of the eight heavy-water lines deep inside the shielding. Temporary repairs were made by encasing each of the eight pipes in a block of epoxy resin; after a full year, the repairs are still serviceable. A brief discussion is presented of some of the problems encountered, such as repair criteria, testing of possible repair materials, tools for remote work, and sand-blasting cleaning of the repair surface. (D.L.C.)

42339 (APDA-147) APDA REACTOR COMPONENTS TEST. R. H. Costello, M. M. Fiedler, J. J. Flis, R. H. Jones, T. E. Lempges, J. Matte, III, and G. Vanmassenhove (Atomic Power Development Associates, Inc., Detroit). Nov. 1962. 465p.

A comprehensive description of the test operation and nonnuclear performance of the APDA Reactor Components Test is given. These activities were carried out in a facility consisting of the reactor, associated fuel handling mechanisms, and one primary sodium loop with pump and heat exchanger. A detailed description is included of the systems and components of the facility, and of the relation of the facility to the total plant. Unusual methods that were used in planning and erection of the facility and which contributed significantly to minimizing the cost and time of erection and testing are outlined. All the test operations conducted are reported, including discussion of the results obtained, unusual methods and tools employed, the few deficiencies discovered, and the modifications and improvements made to ready the test components for nuclear service. (auth)

42340 (BAW-1269) ULTRASONIC INSPECTION OF A SECTION OF THE NS SAVANNAH PRIMARY PIPING SYSTEM. C. R. Johnson (Babcock and Wilcox Co., Lynchburg, Va.). Oct. 1963. Contract AT(11-1)-766. 25p.

A section of NS Savannah primary pipe and part of a primary system gate valve were examined ultrasonically to determine whether a fluctuating flow of low-temperature makeup water entering through a nozzle in the valve had damaged the components during service. Examination was prompted by failure of a Vallecitos Boiling Water Reactor (VBWR) recirculating pipe in which makeup water was introduced under conditions similar to those in the Savannah. The ultrasonic equipment was calibrated on spare components. The calibration standards, 11-mil-deep chisel marks in the pipe and 25-mil-deep marks in the valve, were more stringent than those used to calibrate equipment for inspection of components at the time of manufacture. The inspections of components conducted aboard ship are therefore thought to be more exacting than those performed on the original equipment. Ultrasonic inspections of the failed VBWR pipe completely defined the areas of defective material that led to the failure. The VBWR results, together with experience gained by Babcock & Wilcox, indicate that the inspections of Savannah's components were both applicable and definitive. Since no indications of discontinuities were found in the valve or the pipe, both components are considered to be sound and unaffected by service. (auth)

42341 (CRRCE-1152) EXPERIMENTS ON THE CONSEQUENCES OF BURSTING PRESSURE TUBES IN A SIMULATED NPD REACTOR ARRANGEMENT. P. A. Ross-Ross (Atomic Energy of Canada Ltd., Chalk River, Ont.). Feb. 1963. 84p. (AECL-1736)

Tests conducted to determine if the bursting of one zircaloy pressure tube at normal operating conditions could cause rupture of a second tube and so on, thus producing catastrophic failure of the reactor, are described. It was found that any combination of crack size and coolant temperature which could release a steam-water mixture from the pressure tube into the annulus between the calandria and pressure tubes and build up a pressure of about 550 psi was sufficient to burst the calandria tube. With the calandria tube failure, the explosive decompression of the coolant into the moderator and the ejection of fuel bundles from the ruptured pressure tube could result in extensive damage to surrounding reactor components but did not cause failure of another pressure tube. (auth)

42342 (CVNA-190) MONTHLY OPERATING REPORT [ON CVTR OPERATION], AUGUST 1963. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). Contract [AT(30-1)-2289]. 30p.

The reactor was not operated because of the major rework of the header cavity. Work is continuing in the rod drive trenches and the reworking of the canned insulation is going forward. Work continued in the checking and reworking of the fuel handling equipment including the U-tube drying station. One shutdown cooler was returned from the manufacturer after having been repaired, and the other shutdown cooler is now being reworked. Both component cooling water heat exchangers are at the manufacturer's plant being converted from a two pass to a single pass affair. Because of the rework of the header cavity, the moderator was drained to the dump tank and the primary system partially drained to permit removal of certain components from the header cavity. Because of this, routine sampling of the heavy water was discontinued. Light water chemistry throughout the plant fell well within operating limits, indicating no unusual trends. (auth)

42343 (EUR-420.e) EURATOM PARTICIPATION IN FIVE NUCLEAR POWER STATIONS IN THE COMMUNITY. DESCRIPTION OF THE PROGRESS AND STATUS OF DEVELOPMENT BY MAY 1963. (European Atomic Energy Community). 1963. 128p.

A technical description of the five nuclear power plants

in the European Community in which EURATOM is participating is presented. In each of these projects, the status of the work is given and also the conditions relating to EURATOM's participation. The SIMEA plant has reached the full-load stage, the SENN plant is nearing this stage, construction of the SENA plant is well under way, the civil engineering work is being carried out on the KRB plant, while the detailed designing work for the SEP project has got off to a good start. (N.W.R.)

42344 (HW-77273) CONTRIBUTIONS OF THE PRTR TO REACTOR TECHNOLOGY. H. Harty and J. C. Fox (General Electric Co. Hanford Atomic Products Operation; Richland, Wash.). July 2, 1963. Contract AT(45-1)-1350. 13p.

The significant contributions to reactor technology that have been or are being demonstrated in the Plutonium Recycle Test Reactor are briefly reviewed. Reactor design features, reactor components and construction methods, and reactor operation are the aspects covered. (auth)

42345 (LAMS-2984) QUARTERLY STATUS REPORT ON ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) FOR PERIOD ENDING SEPTEMBER 20, 1963. (Los Alamos Scientific Lab., N. Mex.). Oct. 1963. Contract W-7405-eng-36. 16p.

Construction of the UHTREX facility is about 63% complete and is about 5% behind schedule based on a completion date of February 1964. A series of 64 experimental runs were made in the half-scale flow model of the UHTREX core to investigate the degree of flow unbalance between the 312 fuel channels. It was shown that an initial source of strength of about 10^3 neutrons/sec is to be expected when UHTREX is fueled with 7 kg of enriched uranium (93.5% U^{235}, 1% U^{234}, and 5.5% U^{238}) loaded in graphite by solution impregnation. In an effort to refine the calculated worths of shutdown rods, several two-dimensional IBM 7090 codes, applying both neutron transport and diffusion theory, were used. To simplify the analysis of the UHTREX system's dynamic behavior, the major components for heat exchange are represented by three or four axial lump models. The UHXCOM simulation program solves the basic system differential equations on the IBM 7090 and produces time plots of different operating variables such as reactor power, period, gas temperature, etc. A separate analysis is being made with a frequency domain IBM 7090 program that solves equations written in terms of the Laplace transform variable. Very satisfactory performance was achieved with a process gas chromatograph. The second of two single-stage diaphragm compressors was operated for 20 hr in a shakedown run. Two helium blowers operating on hydrodynamic gas bearings were developed. (M.C.G.)

42346 (MND-M-1818) PM-1 NUCLEAR POWER PLANT PROGRAM. Quarterly Progress Report No. 7, September 1, 1960–November 30, 1960. J. S. Sieg (Martin Co. Nuclear Div., Baltimore). Jan. 6, 1960. Contract AT(30-1)-2345. 166p.

The design, development, fabrication, installation, and initial testing of a prepackaged, air-transportable, pressurized water reactor nuclear power plant, the PM-1, is described. The specific output is 1 Mw(e) and 7 million Btu/hr of heat. The plant is to be operational by March 1962. The principal efforts were concerned with reactor development work, plant fabrication and assembly, and at-site construction work. Major reactor development work included: zero-power testing and analysis, reactor flow and heat transfer testing and analysis, and analytical power plant extrapolation and interpolation from the reference PM design. (auth)

42347 (NAA-SR-Memo-8734) SRE POWER EXPANSION PROGRAM CORE MODIFICATIONS AND CORE III FUEL. TITLE I. R. C. Noyes (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 1, 1963. Contract AT(11-1)-Gen-8. 78p.

Designs were developed for new core components required to modify the SRE core to accomplish the objectives of the PEP program. The reactor is to be operated initially at 30 Mw(t) at a mixed-mean outlet temperature of 1192°F with a 33 element loading of hypostoichiometric uranium monocarbide fuel. New Zircaloy-2 canned moderator elements were designed which will operate at an outlet temperature of 1200°F and which will allow adequate moderator cooling for core powers up to 40 Mw(t). Dry control rods and thimbles were designed to permit increased heating rates. Two types of fuel elements were designed to accomplish the dual objectives of irradiating fuel rods at both ASCR maximum temperatures and power densities, and at maximum temperatures and power densities significantly in excess of ASCR conditions. Thirty standard fuel elements of 8-rod clusters of 0.60-in., 6.5%-enriched slugs are to function both as driver elements and test elements. The four test elements of this type will be located in the first fuel ring and will operate at a maximum nominal centerline temperature of 1717°F and average specific power of 35.1 kw/kgU. At 80% load factor, these test elements will achieve 25,000 Mwd/MTU average burnup in 30 months. The 26 driver elements will require replacements twice during this period to maintain reactivity. Three special fuel elements consisting of 8-rod clusters 0.50-in., 15%-enriched fuel slugs are to be located in the center position and first fuel ring. Fuel in these elements will be irradiated at a maximum nominal centerline temperature of 1905°F and average specific power of 65.6 kw/kgU. At 80% load factor these elements will achieve 25,000 Mwd/MTU average burnup in 18 months. (auth)

42348 (NAA-SR-Memo-8808) NUCLEAR CALCULATIONS FOR THE PNPF. L. A. Mountford and J. R. Hume (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 24, 1963. Contract AT (11-1)-Gen-8. 54p.

The reactivity of the Piqua Nuclear Power Facility (PNPF) was calculated at various loadings using a one-region (with reflector savings), four-group diffusion equation. These calculations were checked with a two-region, four-group FOG calculation. The thermal group constants were obtained with the TEMPEST II-S_4 procedure, the fast group constants with FORM. The U^{238} resonance integral was adjusted to make the calculations for the critical assembly fit the measurements and the adjusted parameter was used for the PNPF calculations. The minimum critical loading at 360°F was calculated to be 20.4 elements, with an excess reactivity of 0.22% (31¢) for the minimum critical loading of 21 elements. The excess reactivity was calculated for core loadings of 19, 37, 61, and 85 elements, which result as the outer rings of element positions are filled consecutively. The isothermal temperature coefficient of reactivity was estimated for several core loadings by using the calculated reactivities at 325°F and 585°F. The values of the coefficient for 21- and 61-element loadings are -4.6 and -4.9×10^{-5} delta k/°F, respectively. The largest coefficient is -5.0×10^{-5} delta k/°F at a loading of 36 elements. The kinetics parameters l and β_{eff} were calculated using the PERT program. The lifetime is 5.23×10^{-5} seconds at 325°F and 5.67×10^{-5} at 585°F. Beta effective ranged from 0.00689 for an 85-element loading at 325°F to 0.00728 for a 19-element loading at 585°F. A value of 0.0070 was chosen for kinetics calculations. (auth)

42349 (NP-13105) IZUCHENIE TOPLIVNYKH ELEMENTOV NO OSNOVE SPECHENOI DVUOKISI URANA DLYA ENERGETICHESKIKH REAKTOKOV. (Study of Sintered Uranium Dioxide Base Fuel Elements for Power Reactor). R. S. Ambartsumyan, V. V. Goncharov, et al. (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1963. 15p.

Data are given from loop tests carried out on thirty fuel elements prepared from sintered uranium dioxides. General data are also included on the performance of fuel elements in the icebreaker "Lenin." (R.V.J.)

42350 (ORNL-3361) ACTIVITY RELEASE FROM THE N.S. SAVANNAH IN THE MAXIMUM CREDIBLE ACCIDENT. T. D. Anderson, J. R. Buchanan, W. B. Cottrell, M. H. Fontana, O. H. Klepper, and H. C. McCurdy (Oak Ridge National Lab., Tenn.). Oct. 16, 1963. Contract W-7405-eng-26. 118p.

The release of fission products that would occur following the maximum credible accident aboard the N.S. Savannah has been examined. Four significantly different, but realistic, operating histories were considered. The rate of release of noble gases and of iodine isotopes as a function of time after the accident was determined for each operating history and for both normal and emergency reactor-compartment ventilation systems. The influence of radioactive decay and of the time delay in release and transport of activity through the containment system was investigated. Most of the results are expressed in terms of activity release and resultant individual exposures, although some consideration is given to population exposures and to the interpretation of these results in the light of stationary reactor site criteria. (auth)

42351 (ORNL-TM-709) STATUS REPORT ON OXIDATION ANALYSES FOR THE EGCR. M. H. Fontana (Oak Ridge National Lab., Tenn.). June 15, 1961. Contract W-7405-eng-26. 119p.

Work done on the EGCR graphite combustion problem that may follow from the maximum credible accident, that is the rapid loss of pressure from the primary reactor coolant system is summarized. The solution to date is to protect the fuel support sleeves with a siliconized silicon-carbide coating and to allow the moderator surfaces to oxidize. The moderator surfaces have available only 6.5% of the total core flow which places an upper limit on the rate of oxidation. The rate of heat removal through the sleeve to the main coolant flow is sufficient to cause a decrease in temperature throughout the reactor and subsequent quenching of the oxidation. This method depends only on continued coolant flow from one blower. Problems attendant with this and other schemes of controlling the fire are discussed. (auth)

42352 (SRO-94) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, SEPTEMBER 1963. (Savannah River Operations Office, AEC). 10p.

Progress made in the development and operation of heavy water reactors is reported. Information is included on the fabrication and testing of the on-power refueling machine for the Candu Reactor, testing of Candu boiler, creep-rupture testing of SAP, nondestructive testing of fuel cladding, header and feeder piping fluid dynamics, testing of dome-type pressure tube closure seal, zirconium technology, heat transfer at low flux, Candu fuel radioactivity monitoring, Euratom cooperative program, operation of HWCTR, and development of Carolinas-Virginia Tube Reactor. (N.W.R.)

42353 (TID-19425) A.E.C. SPECIFICATION MRB-MA55/286/10000. CONTROL ROD DRIVE SYSTEM FOR NUCLEAR MERCHANT SHIP REACTOR. (Division of Reactor Development. Maritime Reactors Branch, AEC). Revision 3, Dec. 15, 1960. 50p.

The technical requirements for the control rod drive system to be installed in the pressurized water nuclear power plant of a seagoing merchant vessel are covered. (N.W.R.)

42354 (TID-19443) ATOMIC ENERGY COMMISSION–BUREAU OF MINES PROCESS HEAT REACTOR PROGRAM. Quarterly Progress Report, May 1–July 31, 1962 N. H. Coates, W. T. Abel, R. L. Gall, C. C. Shale, J. P. McGee, and L. L. Hirst (Bureau of Mines. Morgantown Coal Research Center, W. Va.). 26p.

The construction of a 250-psig pilot scale He recycle loop is reviewed. The He is the coolant for an electrically Induction-Heated Simulated Nuclear Reactor (ISR). The He temperature at the inlet of the compressor turbine is 1400 to 1600°F. The heat-transfer characteristics and reactor-coolant suitability of He-graphite suspensions are studied. The effects of entrained coal dust and micronized graphite in N_2 on the compression characteristics of the N_2 are studied. An electric precipitator for removal of dust from gases is described. (T.F.H.)

42355 (TID-19475) PROCESS HEAT REACTOR PROGRAM. Quarterly Progress Report, August 1 to October 31, 1962. N. H. Coates, W. T. Abel, R. L. Gall, J. P. McGee, and L. L. Hirst (Bureau of Mines, Morgantown, W. Va.). 21p.

The development of an electrically Induction-Heated Simulated Nuclear Reactor (ISR) is described. The reactor to be produced from the ISR is to use He above 1000°F to heat steam, and the steam is then to be used to gasify coal. The heat transfer characteristics and reactor-coolant suitability of He-graphite suspensions are studied. The effects of entrained micronized graphite in N_2 on the compression characteristics of the N_2 are evaluated. (T.F.H.)

42356 (TID-19496) EXPERIMENTAL GAS COOLED REACTOR. STUDY II-650. PLANT CONTROL ANALYSIS. W. G. Sutton and E. R. Gasser (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Jan. 26, 1961. Contract AT(11-1)-654. 54p. (EGCR-STUDY-II-650)

A study was made to select a plant control system for the EGCR and to demonstrate the adequacy of the selected system by analog computer analysis. The reactor will operate both as an experimental facility and as a load-following power plant. The control system must satisfy the following criteria: the maximum rate of change of fuel-clad temperature for normal operation and controlled changes shall not exceed 2.5°F/sec; fuel-temperature coefficient is negative; steam pressure and temperature at turbine must be maintained at 1265, +35, −60 psia and 903, +12, −33°F; flux must be held constant within the allowable band of ±10% during controlled maneuvers without interference from the safety system; the plant must be able to compensate for load changes at a rate of ±10%/min, normal and ±20%/min, maximum; and reactor outlet coolant temperature must not exceed 1150°F. Results are presented in diagrams and graphs. (M.C.G.)

42357 (TID-19550) ATOMIC ENERGY COMMISSION–BUREAU OF MINES PROCESS HEAT REACTOR PROGRAM. Quarterly Progress Report, November 1, 1961–January 31, 1962. N. H. Coates, W. T. Abel, C. C. Shale, J. P. McGee, and L. L. Hirst (Bureau of Mines. Morgantown Coal Research Center, W. Va.). 29p.

Tests to determine the operating characteristics of the 250-psig helium-recycle compressor were completed.

Helium flow was varied from 2000 scfh to the maximum flow that did not overload the compressor motor over the ranges 100 to 250 psig and 100 to 1000°F. There was no unstable operation. Work is continuing on construction of the coal gasifier for the Induction-Heated Simulated Nuclear Reactor System. Helium and helium–graphite suspensions were recycled through the loop to determine their compressor power requirements and heat-transfer properties. Tests were made to establish limits of parameters for a statistical study of the effect of variables on dust-removal efficiency of the electrostatic precipitator. (M.C.G.)

42358 (TID-19551) ATOMIC ENERGY COMMISSION–BUREAU OF MINES PROCESS HEAT REACTOR PROGRAM. Quarterly Progress Report, February 1–April 30, 1962. N. H. Coates, W. T. Abel, R. L. Gall, C. C. Shale, J. P. McGee, and L. L. Hirst (Bureau of Mines. Morgantown Coal Research Center, W. Va.). 27p.

A flowsheet for the Induction-Heated Simulated Nuclear Reactor (ISR) system with a coal gasifier is given. All major components for the ISR gasification system were fabricated and installed. Work on piping and instrumentation is in progress. The helium–graphite suspension loop is being modified so that temperature in all parts of the loop are well above the saturation temperature of steam. To accomplish this the water-cooled exchanger is being replaced by an exchanger cooled with boiling glycol and the compressor is being modified to operate at temperatures to 500°F. Tests with a small loop showed that most of the graphite settled in the impeller housing of the compressor. Equipment is being installed for the pilot-scale helium-graphite suspension loop. Suspensions of powdered coal in nitrogen and micronized graphite in nitrogen were cycled in a loop. Tests were made on an electrostatic precipitator at various temperatures and pressures. (M.C.G.)

42359 (TID-19552) ATOMIC ENERGY COMMISSION–BUREAU OF MINES PROCESS HEAT REACTOR PROGRAM. Quarterly Progress Report, November 1, 1962–January 31, 1963. N. H. Coates, W. T. Abel, R. L. Gall, H. G. Gibson, J. P. McGee, and L. L. Hirst (Bureau of Mines. Morgantown Coal Research Center, W. Va.). 22p.

The Induction-Heated Simulated Nuclear Reactor (ISR) system was operated to establish the effectiveness of the generator for producing superheated steam. In a 48-hr test 2000 to 2200°F helium from the ISR satisfactorily produced steam at 1400 to 1600°F. The steam generator was also used to show the feasibility of using heat from high-temperature helium to reform natural gas. Installation of the fixed-bed gasifier in the ISR system was continued. Tests carried out helium-graphite suspensions as heat transfer media showed that moisture was not causing the graphite to deposit in the heat exchanger. Tests were also made with nitrogen-graphite suspensions to determine the effect of solids concentration on the energy required to circulate suspensions. (M.C.G.)

42360 (TID-19553) ATOMIC ENERGY COMMISSION–BUREAU OF MINES PROCESS HEAT REACTOR PROGRAM. Quarterly Progress Report, February 1–April 30, 1963. (Bureau of Mines. Morgantown Coal Research Center, W. Va.). 18p.

Work was completed on installation of the fixed-bed coal gasifier in the helium-recycle system. Helium from the simulated nuclear reactor generates 1600°F steam that is used to gasify pretreated coal. Tests were conducted to evaluate the gasification characteristics of various fuel cycles that might be used in the gasifier of the pilot-scale helium-recycle system. The helium-graphite suspension loop was modifed by replacing the glycol-cooled exchanger with the original water-cooled exchanger. Suspensions of micronized graphite in nitrogen were recycled in a small loop to determine the effect of solids concentration on the energy required to circulate suspensions. (M.C.G.)

42361 (UCRL-7416) THE TORY II-A REACTOR PROGRAM. Harry Reynolds (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 3, 1963. Contract W-7405-eng-48. 17p. (CONF-281-2)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

The design requirements, the fundamental design problems, and the test facility for the Tory II-A reactor are described. Tory II-A was an engineering test reactor, built and tested to gain information on the materials, engineering, and physics problems. The available air allowed full-power full-temperature operation of the reactor for a period of less than two minutes. The reactor was first operated at 50 Mw in May 1961. In late September and early October of 1961 the reactor was taken to high power three times in succession. These runs were followed by remote disassembly of the reactor. (M.C.G.)

42362 (WAPD-MRP-105) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, June 24, 1963–August 23, 1963. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT(11-1)-Gen-14. 142p.

Progress on the Shippingport Pressurized Water Reactor is reported. Topics covered include: plant modification, plant decontamination, reactor engineering, metallurgy of core materials, core operations, and reactor physics. (N.W.R.)

42363 (WCAP-6056) YANKEE CORE EVALUATION PROGRAM. Quarterly Progress Report for the Period Ending September 30, 1963. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Oct. 1963. Contract AT(30-1)-3017. 177p.

The completion of the first phase of the underwater examination and disassembly of the Yankee Power Reactor Core I is described. The status and results of the hot cell work and laboratory analyses performed to date are reported along with the progress to date on the evaluation of data and the revision of design methods. (N.W.R.)

42364 THE PROBLEM OF THE DYNAMICS OF NUCLEAR POWER PLANTS. P. A. Gavrilov and B. N. Seliverstov. At. Energ. (USSR), 15: 115-20(Aug. 1963). (In Russian)

The results of dynamic tests carried out with a test-stand model of the Beloyarsk Atomic Power Station were compared with data obtained by computation techniques of the mathematical model of the same system. Chemically purified water was used in both primary and secondary systems as the heat transfer agent; the secondary loop included a superheater. Both the steam generating and superheating systems were similar to the corresponding portions of the Beloyarsk Station. The heat conductivity equations of the metallic portion of the fuel elements were replaced by thermal balance equations; the continuous pressure gradient in the steam–water and steam portions was replaced by a stepwise changing curve; the axial excessive flow of heat was not taken into account. The amount of heat needed to reach the saturation of the heat capacity of the heat transfer agent was assumed to be independent of the pressure and temperature; the transversal velocity distribution in the heat transfer agent was also taken as re-

maining constant. The study has shown that the proposed mathematical model is satisfactory for the analysis of dynamic characteristics of test stands and design features of this type of reactors; it may be used for choosing the most suitable control system. The linear model may also be applied to systems with widely differing parameters; the linear and nonlinear models may diverge by as much as 20%. (TTT)

42365 PERSONNEL IRRADIATION DOSES AT THE NUCLEAR POWER STATION OF THE ATOMIC ICEBREAKER "LENIN." V. K. Kovalenko, V. F. Kozlov, Yu. V. Sivintsev, and Yu. I. Smirnov. At. Energ. (USSR), 15: 152-5(Aug. 1963). (In Russian)

In the design of the atomic icebreaker "Lenin" all the necessary steps were taken to protect the personnel against penetrating radiations and the ingestion of radioactive materials. A 1.5 to 2-m thick iron-water and heavy concrete shield was used to shield the reactor core while the primary heat transfer circuit was covered with 380 to 420-mm thick steel plates. The pertinent recommendations of the ICRP and the USSR Ministry of Health were followed; the maximum permissible level was reduced from 15 to 5 rad/year. During the 3-year period from Aug. 1959 to October 1962 the average exposure dose was 1.62 rad/year. The thermal neutron portion of the total was in average only 8% and never exceeded 18%. Exposure of the operating personnel to β radiation and to fast neutrons was found to be negligible. The ingested dose is considered to be zero, as operators were required to wear pressurized suits when working in potentially contaminated areas. This fact was confirmed by the results of systematic measurements of the I^{131} content of the operators thyroid glands. The radiation protection system employed is considered very effective. (TTT)

42366 BRADWELL AND BERKELEY — TWO BRITISH NUCLEAR POWER PLANTS. At. Strom, 9: 57-63(July-Aug. 1963). (In German)

A brief review is given of the English energy politics and the establishment of nuclear power plants. The costs of nuclear energy are considered. Full descriptions are given of both Bradwell and Berkeley. (tr-auth)

42367 MILESTONE: NUCLEAR SUPERHEAT AT PATHFINDER PLANT. K. H. Gruenwald and W. A. Bezella (Allis-Chalmers Mfg. Co., Washington, D. C.). Atomics, 16: 27-31(Sept.-Oct. 1963).

Plant and reactor design data and operation of the Pathfinder are given and operation is discussed. Based on the Pathfinder reactor, the capital and energy costs of future superheat and superheat-reheat reactors are given. (P.C.H.)

42368 THE IMPACT OF GRAPHITE FUEL DEVELOPMENT ON HIGH-TEMPERATURE STEAM GENERATION. R. A. Meyer and C. L. Rickard (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Atomkernenergie, 8: 303-10(Sept. 1963).

The thermodynamic and economic incentive for the development of high-temperature graphite fuel, the potential it holds for the generation of high-temperature steam, and the associated development and testing work are discussed. The fuel element design that evolved from work on the High-Temperature Gas-Cooled Reactor (HTGR) is described. It is a solid semihomogeneous type in which graphite serves as the moderator, cladding, fuel matrix, and structure. The uranium and thorium within the fuel compacts is in the form of carbides, uniformly dispersed as particles in a graphite matrix. This fuel element gives the expectation of achieving fuel-cycle costs in the range of 1.0 to 1.5 mill/kw-hr for first generation power plants in the 300 to 500 Mw(e) range. The fuel offers surface temperatures high enough to permit the utilization of the most efficient steam cycles, prospects of achieving fuel burnups in the 50,000 to 100,000 Mwd/ton range, and breeding or near-breeding operation. (M.C.G.)

42369 THE SHIELDING OF POWER REACTORS. H. Weber (Siemens-Schuckertwerke AG, Erlangen, Ger.). Atomwirtschaft, 8: 409-14(July-Aug. 1963). (In German)

Twenty per cent of the power released in a reactor takes the form of radiation which is itself, within a few per cent, reabsorbed in the reactor. Since the activity appears at the most diverse places of a reactor installation it is necessary to isolate the various sources by individual screening. The reactor itself is surrounded by the so-called primary shield while the ratioactive circulatory systems, auxiliary and accessory installations are screened by secondary shields. Physical considerations dictate in the first instance the choice of screening materials. Scattering and absorption processes account for the attenuation of a neutron flux. Costs, space requirements, and weight play, next to the physical considerations, an important role in the lay-out of screening systems. Among screening materials concrete occupies a special position which is dealt with in detail. By the choice of suitable additives concrete densities of up to nearly 7 g/cm^3 may be reached. (auth)

42370 THE THERMAL AND HYDRAULIC CHARACTERISTICS OF POWER REACTOR FUEL BUNDLE DESIGNS. A. D. Lane (Atomic Energy of Canada Ltd., Chalk River, Ont.), G. T. Leaist, R. D. Page, and R. J. Klock. Can. J. Chem. Eng., 41: 226-34(Oct. 1963).

The type of fuel bundle evolved for the various Canadian heavy water-moderated power reactors is described. The data necessary for estimating the thermal and hydraulic characteristics of this type of fuel bundle are indicated. The calculations and experimentation undertaken in the general fields of fluid flow, heat transfer, and coolant mixing are then described. The future use of this type of fuel bundle with coolants proposed for more advanced reactor types is also discussed. (auth)

42371 8th NUCLEAR REPORT. W. L. Felsen. Elec. World, 159: No. 20, 105-12(May 20, 1963).

Current progress on breeder reactor facilities is reported. General data and costs are given for nuclear power plants in operation in the United States, France, Italy, India, and the United Kingdom, and for those under construction. (R.E.U.)

42372 BR-3: THE FIRST BELGIAN NUCLEAR POWER PLANT. [PART] I. R. Doyen. Electricite, 109: 26-47(Feb. 1963). (In French)

The general functional principles of a nuclear power plant of the PWR type and some of the new problems it presents with respect to classic installations are examined. Emphasis is placed on the particularities of the operating mechanisms in a nuclear plant and the terminology associated with them. Some of the unusual components of the BR-3 and the problems in exploitation are described. (tr-auth)

42373 BR-3: FIRST BELGIAN NUCLEAR POWER PLANT. PART III. R. Doyen. Electricite, 111: 39-68 (July 1963). (In French)

The operation of the plant is described in the concluding section. The general operational principles are summarized, and the safety precautions are discussed in some detail. Duties of the operational, maintenance, and monitoring departments are briefly indicated. (J.S.R.)

42374 THE BOILING-WATER REACTOR; A PROMISING NUCLEAR POWER EQUIPMENT. V. E. Doroshchuk and Yu. N. Makarov. Elektr. St., No. 4, 11-14(1962).

Advantages of the boiling-water reactors over the pressurized-water type for nuclear power equipment are reviewed. Ways of improving the economics of boiling-water reactors are discussed. A nuclear power station is being constructed in the USSR with a graphite moderated water-cooled reactor in which the saturated steam will be superheated in the reactor. (TCO)

42375 CONTRIBUTION OF THE MECHANICAL EQUIPMENT INDUSTRY TO THE CONSTRUCTION OF NUCLEAR POWER PLANTS. Maria Alicia Crespi Gonzalez (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 7: No. 26, 15-20(Apr.-June 1963). (In Spanish)

Some of the problems in mechanical equipment presented by the reactor construction are briefly described. The particular difficulties presented by water-cooled reactors, gas-cooled reactors, organic-cooled reactors, homogeneous reactors, and liquid metal-cooled reactors are indicated. (J.S.R.)

42376 DATA PROCESSING. I. EDF-2 POWER PLANT. Robert Morin and Serge Poutonnet. Ind. At., 7: No. 7-8, 97-103(1963). (In French)

Because of the large amount of information to be processed in nuclear power plants, it is necessary to simplify the problem, as was done in EDF-2, by separating the processing into two independent parts, measurements and signals. Detailed explanations are given on the operations connected with them, the fast monitoring, and the regulation of the quantity of CO_2 and the neutron flux. These functions are characteristics of the processing system at the EDF-2. Data on the Citac-210-B computer are given. (tr-auth)

42377 DATA PROCESSING. II. EDF-3 POWER PLANT. Robert Morin and Charles Grunberger. Ind. At., 7: No. 7-8, 103-11(1963). (In French)

Data processing at EDF-3 shows certain progress with respect to EDF-1 and EDF-2, principally by centralization of information. The monitoring of accidents, such as cladding rupture, was principally perfected. Special measures were taken to insure the reliability of the machine, and detailed descriptions of these measures are given. (tr-auth)

42378 EARTHQUAKE RESISTANT DESIGN OF CALDER HALL IMPROVED TYPE NUCLEAR POWER STATION IN TOKAI-MURA. [PART] II. ASEISMIC STUDIES OF EARTHQUAKE RESISTANT PROBLEMS. Kiyoshi Muto (Tokyo Univ.). Nippon Genshiryoku Gakkaishi, 5: 774-85(Sept. 1963). (In Japanese)

The results of studies made on the earthquake resistant design of the Calder Hall improved Type Nuclear Power Station at Tokai-mura is presented, along with the conditions of seismic design and the earthquake resistant design. Descriptions are given of the experimental studies and theoretical analysis of the seismic design, especially concerning the reactor core structure and the reactor pressure vessel and its supporting structure. In the reactor core structure, the largest stresses applied to the core graphite blocks during earthquake motion were examined by the vibration test for the purpose of studying dynamic behavior of the core structure, and were compared with the destructive stress obtained by the strength test of the blocks. In the reactor vessel structure, the peak stress figures of the junction between the vessel and its supporting structure were found out theoretically, and moreover, were checked experimentally by photoelastic test and yielding test. (P.C.H.)

42379 THIRD SHIPPINGPORT REFUELING STILL FASTER. Richard E. Barclay and William J. O'Brien (Duquesne Light Co., Pittsburgh). Nucleonics, 21: No. 9, 70-2(Sept. 1963).

The third replacement of the highly enriched "seed" portion of the Shippingport reactor core is compared to previous refuelings. Phases during this operation are described. (R.E.U.)

42380 THE ARDENNES NUCLEAR POWER PLANT. Pierre Gosselin. Votre Elec., 33: 3-11(Mar. 1962). (In French)

The Ardennes nuclear power plant, the construction of which was gegun in 1962, is scheduled to go into operation at the end of 1965. Technical data on the power plant, which will have a pressurized-water reactor, and the treatment and disposal of radioactive wastes are summarized. (J.S.R.)

42381 L'INGEGNERIA CONVENZIONALE NEGLI IMPIANTI NUCLEARI. VI CONGRESSO NUCLEARE DI ROMA 14-15 GIUGNO 1961. (Conventional Engineering in Nuclear Plants. VI Nuclear Congress of Rome. June 14-15, 1961). Rome, Comitato Nazionale Energia Nucleare and Florence, Vallecchi, 1962. 414p. (Prezzo Lire 3000)

In the design and construction of nuclear plants there are important engineering problems, which although conditioned by the consideration of radioactivity, are essentially conventional engineering problems. The 23 papers presented at the Congress are compiled to show the principal engineering problems encountered and the solutions adopted during the construction of nuclear plants. The subjects discussed include architectural problems, city planning considerations, design criteria in waste treatment plants, turbines, and heat transfer. (J.S.R.)

42382 THE ROLE OF CRITICAL EXPERIMENTS IN DESIGNING THE REACTORS FOR THE FIRST ATOMIC POWER STATION AND THE I. V. KUTCHAKOV BELOGARSK ATOMIC POWER STATION. I. M. Kisil, B. G. Dubovskii, A. V. Kamaev, L. A. Geraseva, and Yu. Yu. Glazkov. Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/85, 28p. (CONF-133-34). (In Russian)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

A uranium–graphite zero power reactor was used in critical experiments carried out to obtain data for designing the first Nuclear Power Station. The feasibility of studying reactor physical characteristics using a subcritical assembly of reactor cells (two-zone critical experiment) was evaluated. In the two-zone critical experiment the subcritical assembly was arranged as the Belogarsk power reactor lattice and was placed in the central zone of a uranium–graphite reactor with 2% enriched uranium. With the inserted assembly the system became critical. Physical characteristics of the reactor lattice, the probability of U^{239} resonance absorption, the fast neutron breeding coefficient, and resonance integrals of construction material are discussed. (R.V.J.)

42383 OPERATION OF A CRITICAL MOCK-UP FOR VVR-M. D. M. Kaminker, K. A. Konoplev, Yu. V. Petrov, and R. G. Pikulik (Ioffe Inst. of Physics and Tech., Leningrad). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/84, 20p. (CONF-133-31). (In Russian)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

Critical mock-up operations of the VVR-M reactor with a beryllium reflector and a thermal neutron flux 3×10^{14} n/cm^2 sec at 10 Mw(t) is described. A theoretical evaluation is given of the core configuration and its measurements. Calculations were made for various core configurations, and the results were compared with experimental data for minimum critical masses. Data are also given on safety techniques employed during critical operations. (tr-auth)

42384 THE ROLE OF CRITICAL EXPERIMENTS IN THE CHALK RIVER POWER PROGRAM. A. G. Ward (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/24, 12p. (CONF-133-15)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

Critical experiments have formed a considerable part of the reactor physics program at Chalk River. The ZEEP reactor has been used since 1951 for measurements of buckling, fine structure of the neutron flux distribution, and other related studies. In 1960 the ZED-2 reactor was commissioned for an expanded program of lattice experiments to support the development of heavy-water-moderated power reactors. Current interest is in the use of boiling H_2O or fog as an alternative to D_2O coolant with oxide fuel assemblies, and in the use of organic coolant with uranium carbide fuel. Precise measurements are being made to determine the neutron balance. They complement the buckling measurements and are important in the development of accurate lattice recipes. Problems for future study include the lattice parameters for large fuel clusters, accurate measurements relating to power and void coefficients of reactivity, and the use of Pu to simulate irradiated fuel for lattice experiments. (auth)

42385 POWER REACTOR DESIGN AT ZERO POWER. W. C. Redman, K. E. Plumlee, and Q. L. Baird (Argonne National Lab., Ill.). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/39, 33p. (CONF-133-22)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

Numerous research, central station power, propulsion, isotope production, and test reactor designs have been investigated in Argonne's zero power reactor facilities, and related exponential and clean critical assemblies have provided basic data. Several experimental programs are reviewed to present a representative account of recent experiments and to demonstrate the wide variety of reactor design information obtainable in low flux systems. The circumstances which influenced the choice among exponentials, clean criticals, zero power mock-ups, and in situ experiments for the acquisition of the required data are explained, as is the role played by supporting analytical effort. The extent to which reactor design data can be attained prior to actual operation at power is illustrated by specific examples. Such data include shutdown margin, excess reactivity for operational requirements, temperature coefficients, control and safety rods' effectiveness, reactor kinetics, power production patterns, requirements for start-up source and instrument sensitivity, shielding needs, and neutron economy. A brief summary of the current and planned programs for the existing members of, and anticipated additions to, Argonne's family of operating zero power reactors is presented. (M.P.G.)

42386 THE ROLE OF THE FAST CRITICAL FACILITY IN THE POWER REACTOR PROGRAM. R. L. McVean, W. G. Davey, and G. J. Fischer (Argonne National Lab., Ill.). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/34, 50p. (CONF-133-23)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

Because of its versatility, the Zero Power Reactor III (ZPR-III) has been an invaluable aid in the development of fast reactor technology for the power reactor program. Recent critical experiments include shape-effect studies, comparison with a previous exponential experiment, and two-region critical experiments. A subcritical loading of 20 kg of Pu was made in ½ of the ZPR-III in preparation for future Pu loadings. Studies were made of the neutron flux and γ-dose rates at the bare core face and the temperature increase in the core due to Pu α and γ heating. Much time was spent on ZPR-III studying the EBR-II reactor prior to its final design. A comparison of nuclear parameters measured in EBR-II with those predicted from the critical experiments substantiate the valuable role of the fast critical assembly in the design of a power reactor. The use of multiple-zoned critical experiments to study the characteristics of large, dilute fast power breeder reactors is discussed. Calculated and experimental values of k, central fission ratios, prompt neutron lifetimes, and central reactivity coefficients have been compared for 23 of the ZPR-III assemblies of widely varied compositions. In these assemblies oxide, carbide, and metallic fuels were simulated. The critical core volumes varied from 50 to 660 liters and critical masses from 130 to 500 kgs of U-235. Although this comparison shows that there are many discrepancies and much anomalous data, it is possible to identify possible causes of discrepancies, and, if these identifications are correct, the data can be reduced to a broad pattern. (M.P.G.)

42387 THE ROLE OF EXPONENTIAL AND PCTR EXPERIMENTS AT HANFORD IN THE DESIGN OF LARGE POWER REACTORS. R. E. Heineman (General Electric Co., Richland, Wash.). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/30, 37p. (CONF-133-20)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

Exponential pile measurements have been made at the Hanford Laboratories on graphite-U lattices for almost 15 years. Although the results of these experiments were used to establish the bucklings of proposed production reactors, they also served to advance the understanding of the reactor physics of these systems. The utility of the exponential experiment is limited because of its large size and its lack of sensitivity to small, localized perturbations of the system. An advanced, several region critical facility, the Physical Constants Testing Reactor (PCTR), was constructed to minimize the quantity of materials needed to provide meaningful data. The PCTR has been used to support the reactor physics design of several power reactors and has served as a general purpose facility for the measurement of reactor cross sections and for the determination of both differential and integral reactor physics parameters for various types of multiplying media. Typical data from the exponential piles and the PCTR are reviewed. The use of these facilities for power reactor design, to support changes in operation of existing reactors, as reactor physics tools, and as training devices are contrasted. Comparisons are made of the initial costs and the cost of subsequent operation. The development of new experimen-

tal techniques for use with these facilities and of the demand for a wider variety of experimental data are traced. A brief description of the High Temperature Lattice Test Reactor is presented, and its proposed use is described. (auth)

42388 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to General Nuclear Engineering Corp.). French Patent 1,294,391. Apr. 16, 1962. Priority date May 31, 1960, United States.

A nuclear reactor comprises a fixed central core region and a marginal region the sections of which are adapted to move laterally in order to control the reactivity of the reactor. This method of controlling the reactivity is suitably used in boiling water reactors having a central core region, through which a forced water circulation is provided, and a marginal region with at least a partial natural circulation. Preferably the central region is limited by a series of vertical plane surfaces, each covered with a section of the marginal region pivotally mounted at its upper end while a steering rod, coupled with the lower extremity of said section, serves for moving it in lateral direction between an inner and an outer position and vice-versa. For security this section tends to occupy the outer position if the connection with the steering rod is broken. (IIB)

42389 IMPROVEMENTS RELATING TO BOILING WATER REACTORS AND TO A METHOD FOR CONTROLLING THE POWER SUPPLIED BY SUCH REACTORS. (to General Nuclear Engineering Corp.). French Patent 1,297,686. May 21, 1962. Priority date Aug. 26, 1960, United States.

A steam separating drum that receives the water-steam mixture from the reactor is provided outside the reactor. The drum is connected to the bottom of the reactor for refeeding the separated water. The feed water coming from the condenser is introduced via two lines to the drum, one for injecting into the steam space of the drum, the other for feeding into the water space. The temperature of the water fed to the reactor is controlled by varying the ratio between these two feeding flows. (IIB)

42390 COOLANT-MODERATOR CIRCULATION SYSTEM FOR HETEROGENEOUS NUCLEAR REACTORS. Herrmann Kumpf and Robert Weber (to Siemens-Schuckertwerke AG). U. S. Patent 3,108,937. Oct. 29, 1963. Priority date July 17, 1957, Germany.

A power reactor is described, which has a single circulation system for the coolant-moderator liquid. Branched from that system is a conduit at a point located externally of the reactor and behind the heat exchanger relative to the flow direction. The external branch conduit is connected with the moderator space of the reactor so as to pass into that space only a fraction of the total quantity of circulating liquid as needed for moderating purposes. A device for further cooling of the fractional quantity of liquid is inserted in the branch conduit. (M.C.G.)

42391 POWER PLANT USING A STEAM-COOLED NUCLEAR REACTOR. Frederick Nettel and Tetsuichiro Nakanishi. U. S. Patent 3,108,938. Oct. 29, 1963. Filed Oct. 30, 1959.

A method of providing efficient and economic means for obtaining reheat from nuclear heat is described. A steam-cooled steam-moderated reactor produces high-pressure, high-temperature steam. A multi-stage steam turbine partially expands the high-pressure steam, which is then withdrawn and reheated, and then further expanded for producing useful power. The saturated steam is superheated by leading it through tubular passages provided in the fuel assemblies of a nuclear reactor, leading the useful part of the superheated steam into a steam turbine in which it expands to a predetermined intermediate pressure, leading the steam at that reduced pressure from the turbine back into the reactor where it is reheated by flowing through other tubular passages in the fuel assemblies, and returning the reheated steam to the turbine for further expansion. (M.C.G.)

Research Reactors

Refer also to abstracts 40698, 40702, 41096, 41108, 41112, 41131, and 41728.

42392 (AID-62-197) SOVIET EXPERIMENTAL PULSED REACTOR. REVIEW OF SOVIET LITERATURE. AID Work Assignment No. 31. (Library of Congress, Aerospace Information Div., Washington, D. C.). Dec. 5, 1962; 8p. (AD-291909)

The proposed Soviet experimental pulsed reactor using a water solution of an enriched uranium salt as fuel is described. General construction details, operating principles, and reactor parameters are covered. Schematic diagrams of the reactor and curves of reactor parameters are included. (auth)

42393 (CONF-39-98) PROCESS-CELL VS. BUILDING-TYPE CONTAINMENT FOR ARGONNE ADVANCED RESEARCH REACTOR. R. W. Seidensticker and W. J. Riordan (Argonne National Lab., Ill.). [nd]. Contract [W-31-109-eng-38]. 14p.

From American Nuclear Society 9th Annual Meeting, Salt Lake City, June 1963.

Research reactors which operate at very high flux and power levels generally require more extensive containment features than the lower power facilities. This, in turn, results in higher capital costs and may place undesirable access limitations on the experimenters. A possible solution to this problem is described. Basically, cell-type containment is nothing more than utilizing the inherent structural strength of the biological shield and associated structure for containment purposes. Comparisons are made between the usual steel and/or concrete building envelope enclosing the reactor facility and the cell-type enclosure. Advantages and disadvantages of both are presented. Because of the preliminary nature of the AARR design it is not possible at this time to choose between the two approaches; however, it is hoped that the presentation of this concept will serve to stimulate others in their quest for better solutions to the containment problem. (auth)

42394 (HW-77607) PLUTONIUM RECYCLE CRITICAL FACILITY LIGHT WATER DILUTION. V. W. Gustafson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 20, 1963. Contract AT(45-1)-1350. 4p.

A study was made of the reactivity status in the PRCF following a cell flooding event which would add H_2O to the core. A 55-inch D_2O moderator level was assumed, and a fuel loading of 17 Pu–Al Mark I type fuel elements on an 8-inch equilateral triangular lattice was calculated to have a critical moderator level at 55 inches. The effects of H_2O dilution of D_2O on the reactivity were calculated up to 50% dilution (110-inch moderator level) and are shown graphically. A continuous reactivity decrease was noted with increasing H_2O addition. (D.L.C.)

42395 (IDO-16888) SPERT II REACTOR FACILITY. C. R. Montgomery (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Aug. 23, 1963. Contract AT (10-1)-205. 145p.

The Special Power Excursion Reactor Test II (Spert II) reactor is a pressurized-water research reactor for conducting reactor kinetic behavior and safety investigations. The facility incorporates sufficient flexibility to permit studies on a variety of cores using a variety of reflectors, especially heavy water. It is designed for operations up to pressures of 375 psig and temperatures of 400°F with flow rates up to 20,000 gpm. The engineering features of the reactor and supporting process equipment are described. (auth)

42396 (IDO-16903) A STATISTICAL DETERMINATION OF THE REDUCED PROMPT NEUTRON GENERATION TIME, $\Lambda/\bar{\beta}$, IN THE SPERT IV REACTOR. Roger Lee Johnson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Aug. 1963. Contract AT(10-1)-205. 60p.

An experimental determination of the reduced prompt neutron generation time $\Lambda/\bar{\beta}$ in the Spert IV reactor utilizing a technique based on the statistical behavior of the neutron population is described. A mathematical model including the effects of delayed neutrons that relates the statistic "variance-to-mean ratio of the count rate as a function of counting time" to integral reactor parameters is derived. This model is used in conjunction with subcritical counting measurements from the Spert IV reactor to provide a value of $\Lambda/\bar{\beta}$ that is in good agreement with an independent measurement obtained from super prompt-critical excursion experiments. (auth)

42397 (NP-13203) ESTADO RADIOSANITARIO DEL REACTOR R. A. 1, PERIODO COMPRENDIDO ENTRE EL 1-1-62 Y EL 10-8-62. Informe No. 87. (Health Physics State of the RA-1 Reactor, Period Between 1-1-62 and 10-8-62). Report No. 87. R. Gaspar, O. Moll, and C. Hermelo (Argentina. Comisión Nacional de Energía Atómica, Buenos Aires). 1963. 25p.

The methods used to measure the irradiation levels and the radiation exposure of personnel of the RA-1 reactor are described. The criteria used to evaluate the risks from this exposure are reported. Typical graphs are shown of the radiation levels measured in the control room. (J.S.R.)

42398 (ORNL-3458) SPECIFICATIONS AND PROCEDURES USED IN MANUFACTURING U_3O_8–ALUMINUM DISPERSION FUEL ELEMENTS FOR CORE I OF THE PUERTO RICO RESEARCH REACTOR. W. J. Kucera, C. F. Leitten, Jr., and R. J. Beaver (Oak Ridge National Lab., Tenn.). Oct. 21, 1963. Contract W-7405-eng-26. 65p.

A thin plate-type element containing a dispersion of 20% enriched U_3O_8 was developed and successfully used in the 5-Mw pool-type research reactor at the Puerto Rico Nuclear Center. The underlying criteria that guided the design are presented. The technological factors, such as compatibility, corrosion resistance, and irradiation behavior, which led to the selection of U_3O_8 as the fissile compound and aluminum as the cladding and matrix material, are reviewed. The fabrication procedures developed and adopted for manufacturing the component are presented. The scheme involves incorporation of 65 wt % U_3O_8 into aluminum compacts by powder metallurgy techniques, preparation of composite fuel plates by roll cladding, assembly of fuel plates into an integral unit by either the roll-swaging or pinning techniques, and corrosion protection of the element by an anodizing treatment to increase service life. Quality control measures adopted to ensure dimensional tolerances are described. Mechanical joining proved to be an economical method for assembling the pool-type fuel elements within dimensional specifications. (auth)

42399 SHIELDING AGAINST RADIATION ORIGINATING FROM THE KEMA SUSPENSION TEST REACTOR (KSTR). [PART] I. Hub Wijker. Atoomenergie Haar Toepassingen, 5: 187-94(Sept. 1963). (In Dutch)

In a discussion of radiation shielding of the KSTR, the following points must be taken into consideration: the introduction of thermal shields between the reactor and the adjacent walls of the reactor hall, insertion of biological shields between the radiation source and the irradiation rooms, dispersion of radioactive gases from the chimney, cladding of radioactive fission products, and the treatment of solid and liquid radioactive wastes. The first two points are discussed. (tr-auth)

42400 ROLE OF CRITICAL, EXPONENTIAL AND SMALL LATTICE EXPERIMENTS IN DESIGN OF SPECTRAL SHIFT CONTROL REACTOR. T. C. Engelder, L. G. Barrett, R. H. Clark, and N. L. Snidow (Babcock and Wilcox Co., Lynchburg, Va.). Vienna, International Atomic Energy Agency, 1963, Preprint SM-42/41, 55p. (CONF-133-19)

From International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963.

The Small Lattice Experiment (SLE) consists of a 0.5-ft^3 test region containing the experimental lattice surrounded by a 2-ft diameter buffer region having similar nuclear properties. This in turn is enclosed in an 8-ft diameter driver region which is a graphite honeycomb loaded with sufficient graphite and/or U^{235} to achieve criticality. By suitable adjustment, the buffer produces an asymptotic spectrum throughout the test region, permitting standard cell measurements at comparatively high power levels. Furthermore, k_∞ of the test lattice can be derived from poisoned test region-void reactivity comparisons. SLE and critical experiment measurements of ρ_{28}, δ_{25}, $\bar{\nu}_m/\bar{\nu}_f$ and k_∞ in a common epithermal lattice (4% enriched UO_2 rods, 70% D_2O in H_2O moderator) agree within ½%. A generalized theoretical method for deriving k_∞ from experimental data is given. Spectral mismatch errors are analyzed to show that accurate k_∞ measurements can be made with less than 1% of the test fuel required for an equivalent critical experiment. The application of SLE techniques to Th recycle SSCR design problems, particularly U^{233} effects, is discussed. The application to reactor design and the relative cost of direct k_∞ measurements vs k_{eff} and B^2 from critical and/or exponential experiments are evaluated. A comprehensive experimental program developed to support the design of the Spectral Shift Control Reactor is discussed. (M.P.G.)

SPACE APPLICATIONS AND TECHNOLOGY

42401 (AD-296862) FEASIBILITY DETERMINATION OF A NUCLEAR THERMIONIC SPACE POWER PLANT. Quarterly Technical Progress Report, November 1, 1962 through January 31, 1963. (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AF33(657)-8977. 39p. (AN-856)

Design and performance feasibility studies are made for a nuclear thermionic space power plant. Topics covered include: bond investigation of alumina-coated niobium tubing with molybdenum coating (both coatings applied by plasma spraying) and finally sealed with a molybdenum sleeve brazed to the molybdenum coating, heat rejection problems of thermionic radiators, package power reactor characteristics, and natural-convection loop configuration and fabrication. (N.W.R.)

42402 (HW-SA-3205) REACTORS IN SPACE APPLICATIONS. H. Harty (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 18, 1963. Contract AT(45-1)-1350. 11p. (CONF-278-1)

From Institute of Electrical and Electronics Engineers, Richland, Wash., Sept. 1963.

The use of nuclear reactors in space for propulsion and for power generation is discussed. Reasons for space applications of reactors are outlined. The reactors proposed for uses in space and their status are described. (M.C.G.)

42403 (LADC-5961) ROLE OF LARGE THRUST NUCLEAR POWER IN MARS FLIGHT. Keith Boyer (Los Alamos Scientific Lab., N. Mex.). [January 1963]. Contract W-7405-eng-36. 17p. (CONF-260-1)

From Symposium on the Exploration of Mars, Denver, June 1963.

A study of the manned exploration of Mars mission indicates that the vehicle propulsion requirements could be met by the development of a 250,000 lb thrust nuclear propulsion engine to be used both singly and in clusters of four. It appears feasible to conduct the development on a time scale which permits a mission attempt in the 1973-1975 time period. No reuse of the engines is proposed and the burning time is restricted to a maximum of 30 minutes. (auth)

42404 PROTECTING EXPLORER XVI SOLAR CELLS. John L. Patterson and William E. Miller (Langley Research Center, Langley Field, Va.). Astronaut. Aerospace Eng., 1: 48-51(Oct. 1963).

An experimental program was carried out to establish the additional window thickness required for protection of solar cells in satellites from radiation belts and to qualify types of fused quartz that could be procured rapidly. Samples of the Explorer XVI solar cells and protective shielding materials were irradiated with 1.2-Mev electrons. It was found to be possible to suitably protect even older type P-N cells to the point where service lifetimes greater than one year in the artificial radiation belt may be obtained. It was concluded that bremsstrahlung damage may possibly be greater than was previously estimated, thus making it impossible to totally shield extremely radiation-sensitive solar cells. Of the 1.2-Mev electrons that were transmitted through a $\frac{1}{16}$-in.-thick quartz shield, only a small per cent got through with energy greater than the damage threshold of silicon. Small differences in quartz made major differences in darkening under irradiation. Quartzes that darkened severely did so in the early part of the dose. (M.C.G.)

42405 POTENTIALS OF RADIOISOTOPE ELECTROSTATIC PROPULSION. William R. Mickelsen and Charles A. Low Jr. (Lewis Research Center, Cleveland). Astronaut. Aerospace Eng., 1: 52-7(Oct. 1963).

The potentialities and problems of a radioisotope electrostatic propulsion system for future space missions are discussed. The proposed operation of an electrogenerator using Ce^{144} – Pr^{144} fuel is described. The availability and cost of Ce^{144} are considered, along with payload radiation damage, spacecraft design, launch-pad and boost hazards, and interplanetary mission performance. The anticipated availability of Ce^{144} as a byproduct from ground-based power reactors is sufficient for propulsion systems of 10 to 50 kw(e) in 1967 and 100 to 500 kw(e) in 1980. The payload radiation dose caused by Ce^{144} electrogenerators was shown to be within acceptable limits even without shielding. Mass components, such as solar flare shelters and/or propellant appeared to be adequate for shielding the crew from Ce^{144} radiation in manned interplanetary flight. (M.C.G.)

42406 ISOTOPE-HEATED HYDRAZINE ENGINE. J. S. Martinez, L. J. Van Nice and A. F. Grant (Space Technology Labs. Inc., Canoga Park, Calif.). Astronaut. Aerospace Eng., 1: 82(Oct. 1963).

The NIMPHE (nuclear isotope monopropellant hydrazine engine) employs an encapsulated radioisotope located in thermal contact with the thrust chamber catalyst bed to heat the bed to the temperature level necessary to achieve the specified starting transient for rocket engines. These systems deliver significantly higher specific impulses than unheated systems for intermittent pulsed applications. (M.C.G.)

42407 ION ROCKET WITH A PERMANENT MAGNET. Paul D. Reader (Lewis Research Center, Cleveland). Astronaut. Aerospace Eng., 1: 83(Oct. 1963).

The feasibility of utilizing a permanent-magnet circuit to provide the magnetic field of the shape and strength required for the efficient operation of a low-current-density electron-bombardment ion rocket was investigated. The ion-chamber performance of the permanent-magnet thrustor was almost exactly the same as the field-coil thrustor chamber performance. The maximum performance difference occurred at an off-design point at which the permanent-magnet thrustor showed ionization process losses about 10% less than the field-coil unit. Substitution of the permanent-magnet circuit for the field coil produced no significant weight change. (M.C.G.)

42408 TEST-BAND MONITORS SET FOR LAUNCH. John W. Wasik. Electronics, 36: 57-8; 60(Oct. 18, 1963).

The planned launching of satellites that will "watch" space for nuclear weapon tests is discussed. Provisions for detection, information transit, and power availability are presented. (R.E.U.)

42409 ROVER FLIGHT SAFETY. L. D. P. King (Los Alamos Scientific Lab., N. Mex.). Nucl. News, 6: No. 11, 3-6(Nov. 1963).

A description is given of some of the work directly concerned with safety aspects of the reactor in the Rover Flight Safety Program. Post-operational reactor disposal is discussed. (R.E.U.)

42410 THE ORBITING GEOPHYSICAL OBSERVATORIES. George H. Ludwig (Goddard Space Flight Center, Greenbelt, Md.). Space Sci. Rev., 11: 175-218(Aug. 1963).

The Orbiting Geophysical Observatories and the supporting ground checkout equipment, data acquisition and track-

ing stations, and data processing equipment are designed to conduct large numbers of diverse experiments in space. Measurements are to be made within the earth's atmosphere, ionosphere, exosphere, magnetosphere, and in cislunar space to obtain a better understanding of earth-sun relations and of the earth as a planet. Designed to meet scientific requirements, the observatories include six booms to support detectors away from disturbances generated in the main body. Five degrees of freedom allow the orientation of experiments relative to three references: the earth, the sun, and the orbital plane. Power, thermal control, and data handling subsystems provide for the proper operation of the experiments and telemetry of the data. Ground stations receive these data, which are then processed into a form suitable for use by the experimenters. The systems were designed to make available a standard spacecraft and support equipment which can be used repeatedly to carry large numbers of easily integrated experiments in a wide variety of orbits. (auth)

42411 NUCLEAR-MAGNETOGASDYNAMIC POWER GENERATION FOR SPACE VEHICLES. Meredith C. Gourdine and Harold M. Larsen (Curtiss-Wright Corp., Wood-Ridge, N. J.). New York, Society of Automotive Engineers, Inc., 1963, Preprint 741C, 10p. (CONF-191-3)

From Society of Automotive Engineers National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Sept. 1963.

A nuclear-magnetogasdynamic (MGD) power generation system is described which is capable of satisfying the long-duration, high power-level mission requirements of space vehicles. In this Rankine cycle system, radio-frequency (r-f) electric fields are used to ionize a cool supersonic gas, and the Hall effect is used to generate electrical power. Following an analysis of MGD energy conversion and r-f plasma production, preliminary design is made of an experimental system having a generator power density of 10 megawatts/m^3 in which 5% of the output power is used to produce the cool plasma. (auth)

42412 THE POTENTIAL OF SOLAR THERMIONICS FOR SPACE VEHICLE POWER. D. L. Dresser (General Motors Corp., Indianapolis). New York, Society of Automotive Engineers, Inc., 1963, Preprint 741B, 12p. (CONF-191-2)

From Society of Automotive Engineers National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Sept. 1963.

A summary is presented on theoretical and experimental results obtained during the past four years on the solar thermionic system. These results provide a basis for estimating the future competitive position of the thermionic system versus solar cells in space power. The basic characteristics of the system are outlined and recent developments are reviewed. A comparison is made of the thermionic and solar cell as power sources. (auth)

42413 NUCLEAR POWERED PROPULSIVE DEVICE. Arthur W. Blackman, Jr. (to United Aircraft Corp.). U. S. Patent 3,108,054. Oct. 22, 1963. Filed June 15, 1960.

A method is described for increasing the efficiency of rocket-type nuclear power plants. A rocket reactor with a controlled oscillating flow of the fluid propellant, which is being heated in the reactor, is considered. The propulsion device has a nuclear reactor core located in a heat-adding chamber. The propellant is pumped through passages in the core for heating and pulsations are induced in the flow to increase the relative heat-transfer coefficient. (M.C.G.)

WASTE DISPOSAL AND PROCESSING

Refer also to abstracts 40537, 41082, 41087, and 41088.

42414 (GAT-R-327) THE VALIDITY AND USE OF SUTTON'S EQUATION AS APPLIED TO STACK EFFLUENTS. E. C. Ashley and B. Kalmon (Goodyear Atomic Corp., Piketon, Ohio). Oct. 1, 1963. Contract AT(33-2)-1. 12p.

A simple determination of the maximum ground level concentrations of radioactive stack gases can be made by using the basic Sutton equation. Using simple assumptions, a correlation coefficient of 0.72 at a 95% confidence level was found between the calculations and sample results. (auth)

42415 (HW-78893) DEHYDRATION OF INORGANIC ION EXCHANGE MEDIA. W. V. DeMier (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 13, 1963. Contract AT(45-1)-1350. 25p.

The feasibility of through-gas drying of several inorganic ion exchange materials was demonstrated by drying from the fully saturated condition to less than 0.4 weight percent residual moisture under conditions suitable for production applications. Water saturated beds were dehydrated at a rate of 0.7 lineal foot per hour with hot (800°F), dry (–100°F dewpoint) air at a superficial rate of 420 pounds per hour per square foot of bed cross section. Particulate loading in the off gas was found to be low; 10^{-4} to 10^{-5} grains per cubic foot. This is equivalent to 0.06 to 0.006 curies of strontium-90 or 0.08 to 0.008 curies of cesium-137 per hour (assuming 2 milliequivalents strontium or cesium per gram of exchanger material). Molecular sieve type AW-400 as currently manufactured by the Linde Company was was found to have little resistance to attrition. Apparently the material used as a binding agent is a major factor in determining the physical properties of the exchanger material. Thermal conductivities of the candidate zeolites were determined in air and in helium at temperatures of interest. (auth)

42416 (ORNL-3355) EVALUATION OF ULTIMATE DISPOSAL METHODS FOR LIQUID AND SOLID RADIOACTIVE WASTES. PART III. INTERIM STORAGE OF SOLIDIFIED WASTES. J. O. Blomeke, J. J. Perona, H. O. Weeren, and R. L. Bradshaw (Oak Ridge National Lab., Tenn.). Oct. 21, 1963. Contract W-7405-eng-26. 43p.

The costs of interim storage of solidified Purex and Thorex wastes in water-filled canals were estimated as the third part of a study to evaluate, from the standpoint of economics and hazards, the various steps leading to and including the permanent disposal of highly radioactive liquid and solid wastes. The wastes were assumed to have been solidified following their production in a plant processing 1500 metric tons per year of uranium converter fuel at a burnup of 10,000 Mwd/ton and 270 tons/yr of thorium converter fuel at 20,000 Mwd/ton. Separate facilities were designed for the storage of the calcined wastes in the acid and reacidified forms, and for the Thorex waste made into a glass. Consideration was given also to storage (in the same facilities) of the combinations acid Purex-acid Thorex and reacified Purex-reacidified Thorex wastes. Costs for interim storage times from 1 to 30 yr were computed for wastes decayed 120 days and 1, 3, and 10 yr at time of initial storage. Costs ranged from 1.5×10^{-3} mill/kwh$_e$ for 1-yr storage of calcined 10-yr-old acid Purex waste to 18×10^{-3} mill/kwh$_e$ for 30-yr storage of calcined, reacified 120-day-old Thorex wastes. Costs of storage of the Purex and Thorex wastes together in the same facility ranged from 1.5×10^{-3} mill/kwh$_e$ for 1-yr storage to 4.8×10^{-3} mill/kwh$_e$ for 30-yr storage for the calcined acid wastes and from 1.8×10^{-3} to 6.3×10^{-3} mill/kwh$_e$ for calcined reacidified wastes. The age of the wastes at time of storage was not a very significant factor, the costs for storage of 10-yr-decayed wastes being only 10 to 15% less than those for storage of the same wastes aged 120 days. Storage of acid wastes as solids was cheaper by factors of 2 to 2.7 than storage of the same wastes as liquids; however, storage of neutralized liquid wastes was slightly cheaper than storage of reacidified Purex and Thorex solids. (auth)

42417 (ORNL-TM-664) COMPARATIVE COSTS FOR FINAL DISPOSAL OF RADIOACTIVE SOLIDS IN CONCRETE VAULTS, GRANITE, AND SALT FORMATIONS. J. J. Perona, R. L. Bradshaw, and J. O. Blomeke (Oak Ridge National Lab., Tenn.). Oct. 23, 1963. Contract W-7405-eng-26. 22p.

Costs were estimated for permanent storage of calcined radioactive wastes in concrete vaults and in rooms mined out of granite formations. In comparison with previously estimated costs for storage in salt mines, costs for concrete vaults were five to seven times as much and for storage in granite about twice as much. This economic advantage, as well as the greater safety it is believed to offer, makes salt the preferred choice. Vaults for storage of calcined solid wastes would be similar in their gross features to many of the tanks built for storage of liquid radioactive wastes, in that they would be underground structures of reinforced concrete with about 10 ft of earth cover and a floor-to-ceiling height of about 15 ft. To make storage in vaults as safe as possible, they were sealed completely from the surface, and space requirements were calculated assuming dissipation of the heat of radioactive decay by conduction through the earth cover. Vaults of two types of concrete were considered: ordinary concrete, capable of withstanding 400 to 500°F, and "high-temperature concrete," capable of 1000°F. Space requirements for storage of calcined wastes in rooms mined out of granite formations are about the same as for storage in salt formations. However, mining costs are higher for granite because heavier equipment is required, drilling is more difficult and slower, and costs of explosives are higher. (auth)

42418 (EURAEC-695) INSOLUBILIZATION OF RADIOACTIVE CONCENTRATES BY ASPHALT COATING. Final Report No. 2 (1st Part), April 1, 1961–March 31, 1963. P. Dejonghe, N. Van de Voorde, J. Pyck, and A. Stynen (Société Belge de Chemie Nucléaire, Brussels). Work Performed under United States–Euratom Joint Research and Development Program. Contract 048-61-4-RDB. 58p. (A translation)

A description is given of a method for asphalt coating insolubilization of various concentrates derived from the processing of radioactive waste: chemical sludge, evaporator residue, incineration ashes. The coating technique described permits one to include 45 parts of dry concentrate in 55 parts of asphalt. However, the concentrate may be injected into the asphalt with a water content ranging from 0 to 99%. The rate of elution of the mixture is about 10^{-6} g/cm^2/day. A description of a pilot plant is given with

the results of operation. Finally, an evaluation was made of the possibilities of applying this technique according to the specific radioactivity of the substance to be coated and the retention properties of the medium. (auth)

42419 (EURAEC-697) INCINERATION OF RADIOACTIVE SOLID WASTE. Final Report [No. 2] (2nd Part), April 1, 1961–March 31, 1963. P. Dejonghe, R. Lopes Cardozo, A. Taeymans, and N. Van de Voorde (Société Belge de Chimie Nucléaire, Brussels). Work Performed under United States–Euratom Joint Research and Development Program. Contract 048-61-4-RDB. 46p. (A translation)

The design and operational testing of the CEN radioactive solid waste incinerator at Mol are described. A collection and inspection technique is described. The incinerator system does not require any gas scrubbing when only normal waste is treated. The problem of de-dusting is treated with respect of eliminating black smokes. Such elimination is necessary because of the premature clogging of the filters in the presence of soot deposits. Two techniques for eliminating soot are being investigated: one consists of a prefilter which is automatically replaced in case of clogging and the other comprises an electrofilter. (N.W.R.)

42420 DEPENDENCE OF THE CHEMICAL STABILITY AND THE CRYSTALLIZABILITY OF GLASS MIXTURES ON THE COMPOSITION AND CONDITIONS OF PREPARATION. Yu. N. Golovanov, N. E. Brezhneva, S. N. Oziraner, A. A. Eremin, and V. L. Zotov. At. Energ. (USSR), 15: 130-8(Aug. 1963). (In Russian)

Fission products may be removed from liquid waste materials by precipitating them on freshly formed metal hydroxides. In order to provide a reliable long-range storage, studies were carried out on the incorporation of these materials into radiation-resistant vitreous masses. The chemical, thermal, and radiation resistance of such glass mixtures, vitrified at relatively low temperatures under admixture of glass-forming agents, was investigated on a mocked-up system consisting of suspensions of Fe hydroxide, Na diuranate, and Ca hydroxide. The ratio of Fe_2O_3, $Na_2U_2O_7$, and CaO in the dried suspension was kept at 1:2:1. The study confirmed the feasibility of transforming radioactive hydroxide residues, ground together with glass-forming agents, into chemically stable glasses. The final product satisfied all the radiation safety requirements. It was also found that in view of the formation of a crystalline phase, extended annealing at 350 to 900° lowers the acid resistance of the glass. Irradiation during the annealing causes increased crystallization. An increase of the melting period from 2 to 6 hours at 1100°C increased markedly the chemical resistance, especially if the SiO content was also increased simultaneously. It was concluded that the chemical stability and the melting temperature depend on the kinetics of the formation of the silicate. (TTT)

42421 THE DISPOSAL OF LOW LEVEL RADIOACTIVE EFFLUENT. C. R. Frost. At. Energy Australia, 6: No. 4, 10-15(Oct. 1963).

Treatment methods for low-level radioactive aqueous effluent are discussed. The methods are chemical precipitation, evaporation, ion exchange, and biological decontamination. (R.E.U.)

42422 PLANNING OF A BERLIN COLLECTING STATION FOR RADIOACTIVE WASTE. F. W. Krahe (Technische Universitat, Berlin) and H. W. Levi. Atomwirtschaft, 8: 442-4(July-Aug. 1963). (In German)

The planning of the Federal Ministry for Scientific Research provides for the treatment of radioactive waste, first by storage in intermediate collecting centers followed at a later date by transfer to a central Federal collecting station. The Berlin collecting center which will be operated by the Hahn-Meitner Institute is to serve not only for the storage but also for the concentration of both liquid and solid radioactive waste as well as for the decontamination of laundry and equipment. Those reponsible for its planning tried to provide only the facilities which were absolutely necessary and with a minimum of expenditure. It was decided to use the evaporation process for the concentration of liquid waste and, on grounds of cost, compression was chosen to reduce the volume of solid waste. The decontamination area is equipped with a washing channel, glove box connections, and large washbasins. The total building costs inclusive of all extras but excluding the evaporator will amount to about DM 1.2 million. (auth)

42423 THE CONTROL OF THE LIQUID RADIOACTIVE WASTE FROM THE MARCOULE CENTER. R. Estoubnel. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 57-64(May-June 1963). (In French)

The residual radioactive waters from the Marcoule Center are more or less contaminated by fission products, uranium, or plutonium. The disposal of these products into the Rhone is only carried out after a thorough purification to avoid pollution of the river water. The radioactive level of the effluents must be sufficiently low so that after dilution the increase in radioactivity of the river remains always within the norms laid down for the population. The procedure for carrying out this control for each disposal operation is described. The experience acquired made it possible to show that the difficulties presented by the disposal of residual waters from a nuclear Center are not insurmountable. The radioactive pollution of a river can be supervised satisfactorily and maintained at a level which causes no harm to the surrounding population. (auth)

42424 THE CONTROL OF THE SURROUNDING RADIOACTIVE POLLUTION. M. Marichal. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 65-72(May-June 1963). (In French)

The natural surroundings of the Marcoule Center are frequently controlled from the radioactive point of view. The flora, either natural or cultivated, the fauna, mainly represented by the fish in the Rhone, the fluvial sediments, the underground water level, and, accessorily, the local milk production, are the main subjects of control which make it possible to follow the evolution of radioactive fixation near the Center. Observations made since 1958 show that the radioactive level is closely linked to the concentration of K^{40}. Although it was possible to demonstrate the occurrence of nuclear tests and their fallout, the controls carried out show that the disposal of Marcoule waste into the atmosphere and into the Rhone has not affected the natural radioactivity of the flora and fauna of the surrounding region. (auth)

42425 THE CONDITIONING OF RADIOACTIVE SOLID RESIDUES. J.-C. Cochet. Bull. Inform. Sci. Tech. (Paris), Nos. 72-3, 107-13(May-June 1963). (In French)

The disposal of solid radioactive waste is discussed including: the radiation risks, the cost of the treatment, and the effect of time on the products treated. An enormous amount of the waste produced has only a weak specific activity; much of it can be incinerated. The waste is collected in containers specially made for each case. After a strict control the residues are sorted out. Their treatment is adapted to the nature of the residues and to the particular

dangers which they present. It is already possible to obtain large reductions in volume for certain categories by the use of a 60 metric ton press. The high activity waste was stored for a while in pits, then it was treated. (auth)

42426 DECONTAMINATION OF RADIOACTIVE WASTE WATER BY FERRIC HYDROXIDE FLOCCULATION. Takashi Matsumura, Toshio Ishiyama, and Tetsuo Mamuro (Radiation Center of Osaka Prefecture). Nippon Genshiryoku Gakkaishi, 5: 656-62(Aug. 1963). (In Japanese)

Experiments involving test flocculations in beakers and in a small flocculator were carried out in the case of ferric hydroxide flocculation. The results showed that the pH value of the reacting medium has a serious effect on the removal. As for radioactive ions, the main decontamination process is completed in the stage in which the ferric hydroxide particles are formed in the reacting medium. Further stirring after this stage causes no further improvement in the removal. The removal of Sr is effectively raised by the addition of equivalent or more amount of carbonate ion when the waste water to be decontaminated contains alkali earth metal ions. No noticeable difference was found between flocculations in a beaker and in a flocculator under the same flocculation conditions. The main role of slurry circulation type flocculator in the decontamination of radioactive waste water is to clarify the effluent by dynamical separation of solid from liquid. (P.C.H.)

42427 HANDLING OF SOLID AND LIQUID WASTES FROM THE BOIS-NOIRS MINE-PLANT COMPLEX OF THE FOREZ DIVISION. PURIFICATION OF EFFLUENTS. P. Chardon and M. Kremer (Centre d'Études Nucléaires, Fontenay-aux-Roses, France). Vienna, International Atomic Energy Agency, 1963, Preprint SM-41/21, 43p. (CONF-104-19). (In French)

From International Atomic Energy Agency Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963.

At the Bois-Noirs plant, the sands separated by centrifuging from the sterile sulfuric-acid leach slurry are used for the hydraulic stowing of the mine. This feature, which is peculiar to this establishment, provides a practical means of disposing of most of the solid wastes (50 to 65%) which keep almost all the Ra out of solution. Fines smaller than 40 μ are passed with the liquid effluents into a settling tank. The U content of the effluents remains within the limits established by the safety standards, but there is an excessive amount of Ra-226 in solution. To remove it, Ra is coprecipitated with barium sulfate in the effluent by means of barium chloride. To eliminate filter systems, the water decanted from the disposal tank is used to carry out the precipitation. The prerequisite for this process is rapid decantation of the barium sulfate precipitate, but this salt produces particles so fine that decantation is possible only after a settling period of several hours. An insoluble Ca salt of straight-chain fatty acids with 15 to 18 C atoms is used to swell the particles of barium sulfate. This salt agglomerates the barium sulfate crystals, and the aggregates decant almost instantaneously. Trials with a scale model were fully satisfactory, the amount of Ra left in the effluents after treatment being less than 10×10^{-12} C/l. Construction of the plant needed for this process is at present being studied. (M.P.G.)

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ä	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

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2302	17-41017	Dep.(mc)
2303	17-42009	Dep.(mc)
2308	17-40691	Dep.(mc)
2314	17-41423	Dep.(mc)
2317	17-40514	Dep.(mc)
2319	17-42044	Dep.(mc)
CEA-Note-	**(French)**	
424	17-41191	Dep.(mc)
CEX-		
61.6.1	17-41018	Dep.; $0.50(OTS)
CLM-P-	**(British)**	
22	17-42113	Phys. Fluids, 6: 1529-36(1963)
CONF-1-	**(Institute of Electrical and Electronics Engineers 1963 Summer Meeting, Toronto, June 1963)**	
25	17-41520	New York, Institute of Electrical and Electronics Engineers, 1963, Preprint 63-1186, ORINS. Gmelin, AED-CONF-63-073-30
26	17-41517	New York, Institute of Electrical and Electronics Engineers, 1963, Preprint 63-1109, ORINS. Gmelin, AED-CONF-63-073-29
CONF-13-	**(American Physical Society Meeting, Houston, Texas, Feb.-Mar. 1963)**	
8	17-42185	ORINS. Gmelin, AED-CONF-63-013-23
CONF-14-	**(American Chemical Society 144th National Meeting, Los Angeles, Calif., March-April 1963)**	
42	17-40921	Dep.(mc); $1.60(fs), $0.80(mf) OTS
CONF-16-	**(International Symposium on the Natural Radiation Environment, Houston, Texas, April 1963)**	
14	17-41135	ORINS. Gmelin, AED-CONF-63-033-12
CONF-18-	**(Polytechnic Institute of Brooklyn Symposium on Optical Masers, New York, Apr. 1963)**	
2	17-40824	ORINS. Gmelin, AED-CONF-63-039-4
CONF-20-	**(3rd Rare Earth Conference, Clearwater, Fla., April 1963)**	
23	17-41543	Dep.(mc); $6.60(fs), $2.27(mf) OTS; Gmelin, AED-CONF-63-040-32
CONF-22-	**(American Physical Society 1963 Annual Meeting, New York, Jan. 1963)**	
27	17-41857	Dep.(mc); $2.60(fs), $0.86(mf) OTS
28	17-42145	ORINS. Gmelin, AED-CONF-63-007-105
CONF-23-	**(American Physical Society, 1963 March Meeting, St. Louis, Mar. 1963)**	
20	17-41544	Dep.(mc); $7.60(fs), $2.45(mf) OTS; Gmelin, AED-CONF-63-022-41
CONF-24-	**(4th Symposium [on] Engineering Aspects of**	

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		Magnetohydrodynamics, Berkeley, Calif., Apr. 1963)
18	17-41663	ORINS. Gmelin, AED-CONF-63-030-19
CONF-39–		(American Nuclear Society 9th Annual Meeting, Salt Lake City, June 1963)
97	17-42158	ORINS. Gmelin, AED-CONF-63-060-105
98	17-42393	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-060-101
100	17-40955	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-060-104
CONF-46–		(American Physical Society 1963 Spring Meeting, Washington, D. C., Apr. 1963)
99	17-41858	Dep.(mc); $3.60(fs), $1.16(mf) OTS; Gmelin, AED-CONF-62-046-133 Phys. Rev., 132: 1625-33(1963)
102	17-41737	Dep.(mc); $2.60(fs), $0.83(mf) OTS; Gmelin, AED-CONF-63-048-111
CONF-48–		(Conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Mar. 1963)
4	17-40762	ORINS. Gmelin, AED-CONF-63-014-15
CONF-49–		(International Symposium on Unit Process in Hydrometallurgy, Dallas, Feb. 1963)
3	17-41518	ORINS. Gmelin, AED-CONF-63-029-2
CONF-60–		(WESCON Institute of Electrical and Electronics Engineers [Conference], San Francisco, Aug. 1963)
2	17-41228	ORINS
3	17-41659	ORINS. Gmelin, AED-CONF-63-128-1
4	17-42148	ORINS. Gmelin, AED-CONF-63-128-2
CONF-62–		(3rd Conference on Reactions Between Complex Nuclei, Asilomar, Calif., Apr. 1963)
15	17-41859	Dep.(mc); $2.60(fs), $0.83(mf) OTS; Gmelin, AED-CONF-63-054-17
16	17-42005	ORINS. Gmelin, AED-CONF-63-054-16
CONF-66–		(Symposium on the Biology of Radioiodine, Richland, Wash., June 1963)
10	17-41022	See HW-SA-3071
CONF-67–		(Health Physics Society 8th Annual Meeting, New York, June 1963)
31	17-41136	ORINS. Gmelin, AED-CONF-63-049-27
CONF-74–		(11th Annual Conference on Mass Spectrometry and Allied Topics, San Francisco, May 1963)
21	17-40825	ORINS. Gmelin, AED-CONF-63-050-38
CONF-78–		(American Physical Society 1963 Summer Meeting, Buffalo, June 1963)
14	17-42147	ORINS. Gmelin, AED-CONF-63-090-25
16	17-41660	ORINS. Gmelin, AED-CONF-63-090-24
CONF-101–		(3rd Annual Symposium [on] Engineering Aspects of Magnetohydrodynamics, Rochester, New York, Mar. 1962)
2	17-42143	ORINS
CONF-104–		(IAEA Symposium on Radiological Health and Safety in Nuclear Materials, Mining and Milling, Vienna, Aug. 1963)
3	17-41159	ORINS. Vienna, IAEA, 1963, Preprint SM-41/1
4	17-41139	ORINS. Vienna, IAEA, 1963, Preprint SM-41/2
5	17-40912	ORINS. Vienna, IAEA, 1963, Preprint SM-41/3
6	17-41161	ORINS. Vienna, IAEA, 1963, Preprint SM-41/4
7	17-41171	ORINS. Vienna, IAEA, 1963, Preprint SM-41/5
8	17-41163	ORINS. Vienna, IAEA, 1963, Preprint SM-41/6
9	17-41155	ORINS. Vienna, IAEA, 1963, Preprint SM-41/7
10	17-41162	ORINS. Vienna, IAEA, 1963, Preprint SM-41/8
11	17-41146	ORINS. Vienna, IAEA, 1963, Preprint SM-41/10
12	17-41145	ORINS. Vienna, IAEA, 1963, Preprint SM-41/11
13	17-41160	ORINS. Vienna, IAEA, 1963, Preprint SM-41/12
14	17-41168	ORINS. Vienna, IAEA, 1963, Preprint SM-41/13
15	17-41172	ORINS. Vienna, IAEA, 1963, Preprint SM-41/14
16	17-41144	ORINS. Vienna, IAEA, 1963, Preprint SM-41/16
17	17-41143	ORINS. Vienna, IAEA, 1963, Preprint SM-41/17
18	17-41142	ORINS. Vienna, IAEA, 1963, Preprint SM-41/19
19	17-42427	ORINS. Vienna, IAEA, 1963, Preprint SM-41/21
20	17-41141	ORINS. Vienna, IAEA, 1963, Preprint SM-41/22
21	17-41154	ORINS. Vienna, IAEA, 1963, Preprint SM-41/23
22	17-41140	ORINS. Vienna, IAEA, 1963, Preprint SM-41/24
23	17-41164	ORINS. Vienna, IAEA, 1963, Preprint SM-41/25
24	17-41152	ORINS. Vienna, IAEA, 1963, Preprint SM-41/26
25	17-41165	ORINS. Vienna, IAEA, 1963, Preprint SM-41/28
26	17-40658	ORINS. Vienna, IAEA, 1963, Preprint SM-41/30
29	17-41153	ORINS. Vienna, IAEA, 1963, Preprint SM-41/35
30	17-41166	ORINS. Vienna, IAEA, 1963, Preprint SM-41/36
31	17-41150	ORINS. Vienna, IAEA, 1963, Preprint SM-41/43
32	17-40914	ORINS. Vienna, IAEA, 1963, Preprint SM-41/44
33	17-41137	ORINS. Vienna, IAEA, 1963, Preprint SM-41/45
34	17-40913	ORINS. Vienna, IAEA, 1963, Preprint SM-41/46
35	17-40760	ORINS. Vienna, IAEA, 1963, Preprint SM-41/49
36	17-41158	ORINS. Vienna, IAEA, 1963, Preprint SM-41/53
37	17-41169	ORINS. Vienna, IAEA, 1963, Preprint SM-41/54
38	17-41149	ORINS. Vienna, IAEA, 1963, Preprint SM-41/56
39	17-41148	ORINS. Vienna, IAEA, 1963, Preprint SM-41/58
40	17-41147	ORINS. Vienna, IAEA, 1963, Preprint SM-41/59
41	17-41138	ORINS. Vienna, IAEA, 1963, Preprint SM-41/60
42	17-41167	ORINS. Vienna, IAEA, 1963, Preprint SM-41/61
43	17-40512	ORINS. Vienna, IAEA, 1963, Preprint SM-41/70

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44	17-40513	ORINS. Vienna, IAEA, 1963, Preprint SM-41/68
45	17-40511	ORINS. Vienna, IAEA, 1963, Preprint SM-41/69
46	17-40510	ORINS. Vienna, IAEA, 1963, Preprint SM-41/67
47	17-41170	ORINS. Vienna, IAEA, 1963, Preprint SM-41/62
48	17-41151	ORINS. Vienna, IAEA, 1963, Preprint SM-41/65
49	17-41157	ORINS. Vienna, IAEA, 1963, Preprint SM-41/66
50	17-41156	ORINS. Vienna, IAEA, 1963, Preprint SM-41/27
51	17-41023	See HW-SA-3161
CONF-117–	**(American Chemical Society 145th National Meeting, New York, Sept. 1963)**	
3	17-41545	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-133-1
CONF-122–	**(International Conference on Nucleon Structure, Stanford, Calif., June 1963)**	
12	17-41736	See BNL-7294
13	17-41843	ORINS. Gmelin, AED-CONF-63-101-15
14	17-41308	ORINS. Gmelin, AED-CONF-63-101-13
CONF-131–	**(Topical Conference on Recently Discovered Resonant Particles, Athens, Ohio, Apr. 1963)**	
2	17-41745	See UCRL-10954
3	17-41746	See UCRL-10955
CONF-133–	**(International Atomic Energy Agency Symposium of Exponential and Critical Experiments with Calculations, Amsterdam, Sept. 1963)**	
4	17-42231	ORINS. Vienna, IAEA, 1963, Preprint SM-42/6
5	17-42229	ORINS. Vienna, IAEA, 1963, Preprint SM-42/3
6	17-42232	ORINS. Vienna, IAEA, 1963, Preprint SM-42/2
7	17-42233	ORINS. Vienna, IAEA, 1963, Preprint SM-42/1
8	17-42238	ORINS. Vienna, IAEA, 1963, Preprint SM-42/11
9	17-42221	ORINS. Vienna, IAEA, 1963, Preprint SM-42/8
10	17-42228	ORINS. Vienna, IAEA, 1963, Preprint SM-42/7
11	17-42223	ORINS. Vienna, IAEA, 1963, Preprint SM-42/89
12	17-42230	ORINS. Vienna, IAEA, 1963, Preprint SM-42/48
13	17-42235	ORINS. Vienna, IAEA, 1963, Preprint SM-42/53
14	17-42006	ORINS. Vienna, IAEA, 1963, Preprint SM-42/64
15	17-42384	ORINS. Vienna, IAEA, 1963, Preprint SM-42/24
16	17-42226	ORINS. Vienna, IAEA, 1963, Preprint SM-42/27
17	17-42237	ORINS. Vienna, IAEA, 1963, Preprint SM-42/31
18	17-42234	ORINS. Vienna, IAEA, 1963, Preprint SM-42/25
19	17-42400	ORINS. Vienna, IAEA, 1963, Preprint SM-42/41
20	17-42387	ORINS. Vienna, IAEA, 1963, Preprint SM-42/30
21	17-42236	ORINS. Vienna, IAEA, 1963, Preprint SM-42/32
22	17-42385	ORINS. Vienna, IAEA, 1963, Preprint SM-42/39
23	17-42386	ORINS. Vienna, IAEA, 1963, Preprint SM-42/34
24	17-42225	ORINS. Vienna, IAEA, 1963, Preprint SM-42/78
26	17-42219	ORINS. Vienna, IAEA, 1963, Preprint SM-42/49
27	17-42007	ORINS. Vienna, IAEA, 1963, Preprint SM-42/46
28	17-42220	ORINS. Vienna, IAEA, 1963, Preprint SM-42/50
29	17-42227	ORINS. Vienna, IAEA, 1963, Preprint SM-42/66
30	17-42218	ORINS. Vienna, IAEA, 1963, Preprint SM-42/83
31	17-42383	ORINS. Vienna, IAEA, 1963, Preprint SM-42/84
32	17-42224	ORINS. Vienna, IAEA, 1963, Preprint SM-42/87
33	17-42222	ORINS. Vienna, IAEA, 1963, Preprint SM-42/86
34	17-42382	ORINS. Vienna, IAEA, 1963, Preprint SM-42/85
CONF-135–	**(International Symposium on High Temperature Technology, Asilomar, Calif., Sept. 1963)**	
2	17-41436	See UCRL-10846
CONF-160–	**(Annual Atomic Energy Commission Contractors Meeting, Nuclear Materials Management, Idaho Falls, Idaho, Oct. 1963)**	
3	17-41327	See HW-SA-3163
CONF-168–	**(21st Annual Meeting of the Electron Microscope Society of America, Denver, Aug. 1963)**	
2	17-41519	ORINS. Gmelin, AED-CONF-63-136-1
CONF-174–	**(12th Annual Conference on Application of X-ray Analysis, Denver, Aug. 1963)**	
5	17-40761	ORINS. Gmelin, AED-CONF-63-123-6
CONF-176–	**(Cryogenic Engineering Conference, Boulder, Colo., Aug. 1963)**	
7	17-41546	Dep.(mc); $2.60(fs), $0.92(mf) OTS; Gmelin, AED-CONF-63-124-10
8	17-41661	Boulder, Colo., National Bureau of Standards, Cryogenic Data Center, 1963, Preprint E-6, $1.75; ORINS. Gmelin, AED-CONF-63-124-9
11	17-41477	ORINS. Gmelin, AED-CONF-63-124-5
12	17-40962	ORINS. Gmelin, AED-CONF-63-124-3
CONF-191–	**(Society of Automotive Engineers National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Sept. 1963)**	
2	17-42412	ORINS. New York, Society of Automotive Engineers, Inc., 1963, Preprint 741B
3	17-42411	ORINS. New York, Society of Automotive Engineers, Inc., 1963, Preprint 741C
CONF-193–	**(8th Nuclear Congress, Rome, June 1963)**	
4	17-41367	For translation see EURAEC-711
5	17-42239	ORINS
CONF-201–	**(Pacific Annual Meeting, Spokane, Aug. 1963)**	
4	17-41229	ORINS. New York, Institute of Electrical and Electronics Engineers, 1963, Preprint 63-1224
6	17-41309	ORINS. New York, Institute of Electrical and Electronics Engineers, 1963,

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		Preprint 63-1203, $1.00
7	17-41188	ORINS. New York, Institute of Electrical and Electronics Engineers, 1963, Preprint 63-1211, $1.00
CONF-202–		**(The Electrochemical Society Fall Meeting, New York, Sept. 1963)**
2	17-41349	See HW-SA-3046
CONF-226–		**(5th Biennial Gas Dynamics Symposium, Evanston, Ill., Aug. 1963)**
4	17-41664	ORINS. New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63-384, $1.00
CONF-235–		**(2nd International Symposium on Effect of Ionizing Radiation on the Nervous System, Los Angeles, Aug. 1963)**
1	17-40545	See BNL-7284
CONF-236–		**(Joint Meeting of the German Roentgen Society and the Germany Biophysical Society, Baden-Baden, Germany, Apr. 1963)**
1	17-40659	See BNL-7207
CONF-240–		**(American Institute of Aeronautics and Astronautics Conference on Physics of Entry into Planetary Atmospheres, Cambridge, Mass., Aug. 1963)**
1	17-42146	ORINS. New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63-461, $1.00
2	17-41662	ORINS. New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63-445, $1.00
CONF-242–		**(American Institute of Chemical Engineers Symposium, Chicago, Ill., Dec. 1962)**
1	17-41734	See WAPD-T-1483(Rev.)
CONF-243–		**(American Nuclear Society Conference on Problems of Operating Research and Power Reactors, Ottawa, Canada, Oct. 1963)**
4	17-42338	See AECL-1844
CONF-248–		**(Symposium on Quantitative Spectroscopy and Applications in Space Sciences, Pasadena, Calif., Mar. 1963)**
1	17-42144	ORINS. Gmelin, AED-CONF-63-086-2
CONF-250–		**(American Physical Society 1963 Summer Meeting in the West, Edmonton, Can., Aug. 1963)**
4	17-41709	ORINS. Gmelin, AED-CONF-63-131-5
CONF-253–		**(13th Annual National Lead Company Analytical and Physical Testing Symposium, Hightstown, N. J., Oct. 1963)**
1	17-41429	See NLCO-892
2	17-41193	See NLCO-893
3	17-40695	See NLCO-887
CONF-255–		**(8th Air Cleaning Seminar, Oak Ridge, Tenn., Oct. 1963)**
3	17-41024	See HW-SA-3187
5	17-40975	See HW-SA-3183
CONF-260–		**(Symposium on the Exploration of Mars, Denver, June 1963)**
1	17-42403	See LADC-5961
CONF-261–		**(Northwest Association of Occupational Medicine Annual Meeting, Richland, Wash., May 1963)**
1	17-41021	See HW-SA-3037
CONF-262–		**(Society for Experimental Stress Analysis Annual Meeting, Boston, Nov. 1963)**
1	17-40958	See UCRL-7499
CONF-264–		**(Conference on Veterinary Toxicology, New York, July 1963)**
1	17-40482	See HW-SA-3085
CONF-265–		**(General Electric Company High Energy Rate Forming Seminar, Schenectady, Sept. 1963)**
1	17-41385	See HW-SA-3189
CONF-266–		**(Symposium on Electronic Aspects of Biochemistry, Rovello, Italy, Sept. 1963)**
1	17-40856	See UCRL-10961
CONF-273–		**(5th Meeting of the Coated Particle Fuels Working Group, Cincinnati, June 1963)**
1	17-41337	See GA-4260
CONF-274–		**(3rd Annual High Temperature Liquid Metal Heat Transfer Technology Conference, Oak Ridge, Tenn., Sept. 1963)**
1	17-40972	See BNL-7319
CONF-275–		**(American Physical Society 1962 Spring Meeting, Washington, D. C., Apr. 1962)**
1	17-41948	Phys. Rev. 132: 1141-6(1963)
2	17-42004	ORINS. Gmelin, AED-CONF-62-046-132
CONF-278–		**(Institute of Electrical and Electronics Engineers, Richland, Wash., Sept. 23, 1963)**
1	17-42402	See HW-SA-3205
CONF-280–		**(International Union of Crystallography 6th General Assembly, Rome (City), Sept. 1963)**
1	17-41361	See UCRL-7245
CONF-281–		**(International Conference on Beryllium Oxides, Sydney, Oct. 1963)**
1	17-41361	See UCRL-7245
2	17-42361	See UCRL-7416
3	17-42188	See GA-4612
CRDC–		**(Canadian)**
1153	17-41489	Dep.; $1.50(AECL)
CRFD–		**(Canadian)**
1012	17-41490	Dep.; $1.00(AECL)
CRRCE–		**(Canadian)**
1152	17-42341	Dep.; $2.00(AECL)
CTSL–		
40	17-41738	Dep.(mc); $5.60(fs), $1.94(mf) OTS
CUA-NE–		
27	17-40974	Dep.(mc); $5.60(fs), $1.79(mf) OTS
CVNA–		**(Misc.)**
190	17-42342	Dep.(mc); $2.60(fs), $1.10(mf) OTS
D–		**(Misc.)**
1-82-0245	17-41666	
1-82-0263	17-42045	
1-82-0273	17-42046	
1-82-0283	17-42047	
2-9878-5	17-41192	
DASA–		**(Misc.)**
1339	17-40956	$6.60(OTS)

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DC–	**(Misc.)**	
58-9-21	17-40778	See TID-6036
DCAS-TDR–	**(Non-AEC)**	
62-167	17-42048	$2.60(OTS)
62-170	17-41240	$1.60(OTS)
62-172	17-41241	$1.60(OTS)
DEP/SEPP–	**(French)**	
153/61	17-42156	For translation see AEC-tr-6093
166/61	17-42198	For translation see AEC-tr-6091
196/62	17-41845	For translation see AEC-tr-6092
197-62	17-42155	For translation see AEC-tr-6056
199/62	17-41847	For translation see AEC-tr-6095
213/62	17-41846	For translation see AEC-tr-6094
DESY-A–	**(German)**	
2.103	17-41739	Dep.(mc)
DMIC-Memo–	**(Non-AEC)**	
172	17-41383	$0.75(OTS)
DP–		
417	17-40922	Dep.(mc); $1.60(fs), $0.80(mf) OTS
434	17-40766	Dep.(mc); $1.60(fs), $0.80(mf) OTS
453	17-40923	Dep.(mc); $1.60(fs), $0.80(mf) OTS
531	17-40924	Dep.(mc); $1.60(fs), $0.80(mf) OTS
603	17-40692	Dep.(mc); $1.10(fs), $0.80(mf) OTS
689	17-40925	Dep.(mc); $3.60(fs), $1.19(mf) OTS
719	17-40926	Dep.(mc); $3.60(fs), $1.28(mf) OTS Proc. Conf. Hot Lab. Equip., 11th, New York, 1963, 75-87(1963)
728	17-40767	Dep.(mc); $1.60(fs), $0.80(mf) OTS
729	17-40927	Dep.(mc); $2.60(fs), $1.10(mf) OTS
748	17-40693	Dep.(mc); $1.10(fs), $0.80(mf) OTS
762	17-40694	Dep.(mc); $1.10(fs), $0.80(mf) OTS
861	17-41019	Dep.; $0.50(OTS)
DPST–		
63-69-9	17-42187	Dep.(mc); $1.10(fs), $0.80(mf) OTS
63-74-8	17-41424	Dep.(mc); $1.10(fs), $0.80(mf) OTS
EANDC-US–	**(European-American Nuclear Data Committee)**	
41	17-41873	See WASH-1044
EGCR-STUDY–		
II-650	17-42356	See TID-19496
IV-303(Rev.1)	17-42323	See ACNP-62573
ESD-TDR–	**(Non-AEC)**	
62-249	17-42049	$1.60(OTS)
EUR–	**(European Atomic Energy Community)**	
413.f	17-41336	Dep.(mc)
420.e	17-42343	Dep.(mc)
422.e	17-41242	Dep.(mc)
429.e	17-41243	Dep.(mc)
EURAEC–		
562	17-41364	Dep.(mc); $5.60(fs), $1.82(mf) OTS
598	17-41437	Dep.(mc); $7.60(fs), $2.39(mf) OTS
645	17-41365	Dep.(mc); $1.60(fs), $0.80(mf) OTS
662	17-41491	Dep.(mc); $1.60(fs), $0.80(mf) OTS
664	17-41366	Dep.(mc); $1.60(fs), $0.80(mf) OTS
695	17-42418	Dep.(mc); $5.60(fs), $1.94(mf) OTS
697	17-42419	Dep.(mc); $4.60(fs), $1.58(mf) OTS
711	17-41367	Dep.(mc); $3.60(fs), $1.34(mf) OTS
758	17-41492	Dep.(mc); $4.60(fs), $1.55(mf) OTS
763	17-41389	Dep.(mc); $5.60(fs), $1.82(mf) OTS
768	17-41390	Dep.(mc); $1.60(fs), $0.80(mf) OTS
771	17-41391	Dep.(mc); $3.60(fs), $1.37(mf) OTS
777	17-42199	Dep.(mc); $4.60(fs), $1.64(mf) OTS
778	17-42200	Dep.(mc); $4.60(fs), $1.46(mf) OTS
779	17-41566	Dep.(mc); $3.60(fs), $1.19(mf) OTS
780	17-41874	Dep.(mc); $1.60(fs), $0.80(mf) OTS
784	17-41368	Dep.(mc); $2.60(fs), $1.01(mf) OTS
790	17-41369	Dep.(mc); $6.60(fs), $2.24(mf) OTS
799	17-41438	Dep.(mc); $1.10(fs), $0.80(mf) OTS
828	17-40954	See ACNP-63028
EXP-NRX–	**(Canadian)**	
3008	17-41490	See CRFD-1012
70911	17-41493	Dep.; $1.50(AECL)
FA-WP–	**(Non-AEC)**	
23/Rev.3	17-42010	Dep.(mc)
FTD-TT–	**(Non-AEC)**	
62-1238	17-42055	$1.60(OTS)
62-1326	17-41567	$1.60(OTS)
63-641	17-40663	OTS
GA–	**(Misc.)**	
4260	17-41337	Dep.(mc); $6.60(fs), $2.24(mf) OTS
4265	17-41844	
4391	17-41338	
4612	17-42188	Dep.(mc); $2.60(fs), $0.92(mf) OTS
GAT-R–		
327	17-42414	Dep.(mc); $1.60(fs), $0.80(mf) OTS
GE–	**(Non-AEC)**	
62FPD365	17-41339	
GEMP–		
27A	17-41340	Dep.; $1.25(OTS)
79	17-42189	Dep.; $0.50(OTS)
243	17-41494	Dep.(mc); $1.50(OTS)
HR–	**(Non-AEC)**	
63-274	17-41425	
HW–		
31186(Del.)	17-40768	Dep.(mc); $4.60(fs), $1.49(mf) OTS
74938	17-41343	Dep.(mc); $1.10(fs), $0.80(mf) OTS
74939	17-41344	Dep.(mc); $1.10(fs), $0.80(mf) OTS
74960	17-41345	Dep.(mc); $1.60(fs), $0.80(mf) OTS
74961	17-41346	Dep.(mc); $1.60(fs), $0.80(mf) OTS
75208	17-41347	Dep.(mc); $1.10(fs), $0.80(mf) OTS
75477	17-41348	Dep.(mc); $1.10(fs), $0.80(mf) OTS
75716(Vol.1)	17-41860	Dep.(mc); $21.00(fs), $9.61(mf) OTS
75716(Vol.2)	17-41861	Dep.(mc); $21.00(fs), $9.78(mf) OTS
75716(Vol.3)	17-41862	Dep.(mc); $21.00(fs), $9.74(mf) OTS
76867	17-40682	Dep.(mc); $1.10(fs), $0.80(mf) OTS
76873	17-40769	Dep.(mc); $1.10(fs), $0.80(mf) OTS
77089	17-41724	Dep.; $0.75(OTS)
77273	17-42344	Dep.(mc); $1.60(fs), $0.80(mf) OTS
77607	17-42394	Dep.(mc); $1.10(fs), $0.80(mf) OTS
77871	17-41725	Dep.; $1.50(OTS)
78461	17-40770	Dep.(mc); $6.60(fs), $2.15(mf) OTS
78893	17-42415	Dep.(mc); $2.60(fs), $0.95(mf) OTS
79182	17-41384	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HW-SA–		
2303	17-40465	Progressive Fish Culturist, 24: No. 2, 56-9(1962)
2859	17-41020	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2863	17-41426	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2867	17-40441	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2869	17-41066	Science, 142: 64-6(1963)
2883	17-40515	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2894	17-40870	J. Inorg. Nucl. Chem., 25: 1298-1300

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		(1963)
2950	17-40546	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2973	17-41067	Science, 142: 66-7(1963)
3037	17-41021	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3046	17-41349	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3071	17-41022	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-063-9
3085	17-40482	Dep.(mc); $3.60(fs), $1.28(mf) OTS
3161	17-41023	Dep.(mc); $3.60(fs), $1.19(mf) OTS
3163	17-41327	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3183	17-40975	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3187	17-41024	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3189	17-41385	$1.10(fs), $0.80(mf) OTS
3205	17-42402	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HW-tr-		
54	17-40782	Dep.(mc); $4.60(fs), $1.67(mf) JCL
IA-	**(Non-AEC)**	
798	17-41294	Radiation Res., 20: 247-51(1963)
820	17-42190	Dep.(mc)
IDO-		
11223	17-42191	Dep.(mc); $2.60(fs), $0.98(mf) OTS
14610	17-40928	Dep.; $2.00(OTS)
16888	17-42395	Dep.; $2.50(OTS)
16903	17-42396	Dep.; $1.50(OTS)
IEA-	**(Non-AEC)**	
54	17-42192	Dep.(mc)
55	17-40907	Dep.(mc)
IITRI-	**(Misc.)**	
B231-9	17-41427	$3.60(OTS)
B6007-4	17-41428	$1.60(OTS)
INSJ-	**(Japanese)**	
60	17-41863	Dep.(mc)
61	17-41864	Dep.(mc)
IS-		
607	17-41865	Dep.(mc); $3.60(fs), $1.40(mf) OTS
613	17-40771	Dep.(mc); $1.60(fs), $0.80(mf) OTS
617	17-41547	Dep.(mc); $1.10(fs), $0.80(mf) OTS
619	17-41372	J. Appl. Phys., 34: 3323-4(1963)
646	17-40724	Anal. Chem., 35: 1887-9(1963)
661	17-41624	Phys. Rev., 132: 1092-7(1963)
JPRS-	**(Non-AEC)**	
21326	17-41568	$6.00(OTS)
JuL-	**(German)**	
104-RC	17-40788	Angew. Chem., 75: 95-6(1963)
105-RC	17-40819	Z. Anorg. Allgem. Chem., 319: 148-58 (1962)
K-		
1582	17-41733	Dep.; $0.50(OTS)
KAPL-		
1306(Del.)	17-40929	Dep.(mc); $6.60(fs), $2.21(mf) OTS
LADC-		
5361	17-40772	Dep.(mc); $2.60(fs), $0.92(mf) OTS
5601	17-42050	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5603	17-41548	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5633	17-41904	Nucl. Instr. Methods, 24: 13-21(1963)
5653	17-41462	J. Less-Common Metals, 5: 432-3(1963)
5656	17-40773	Dep.(mc); $2.60(fs), $1.04(mf) OTS
5658	17-41549	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5664	17-40774	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5848	17-41630	Phys. Rev., 132: 1373-87(1963)
5961	17-42403	Dep.(mc); $1.60(fs), $0.80(mf) OTS
LAMS-		
2960	17-41740	Dep.; $0.50(OTS)
2984	17-42345	Dep.; $0.50(OTS)
LNF-	**(Italian)**	
62/105	17-42159	Dep.(mc)
63/44	17-41741	Dep.(mc)
63/61	17-41742	Dep.(mc)
MATT-		
171	17-42119	Phys. Fluids, 6: 1591-8(1963)
190	17-41611	Phys. Fluids, 6: 1574-8(1963)
MLM-		
1162	17-41350	Dep.; $2.60(fs), $0.86(mf) OTS
MND-	**(Misc.)**	
2739	17-41550	Dep.(mc); $6.60(fs), $2.15(mf) OTS
MND-M-	**(Misc.)**	
1818	17-42346	Dep.(mc); $12.00(fs), $5.18(mf) OTS
N-	**(Misc.)**	
62-11325	17-41495	$4.60(fs), $1.49(mf) OTS
NAA-SR-		
5201	17-42193	Dep.; $0.75(OTS)
8361	17-41351	Dep.; $0.50(OTS)
NAA-SR-Memo-		
8734	17-42347	Dep.(mc); $7.60(fs), $2.54(mf) OTS
8808	17-42348	Dep.(mc); $5.60(fs), $1.82(mf) OTS
8904	17-41866	Dep.(mc); $15.50(fs), $7.13(mf) OTS
NASA-SP-	**(Non-AEC)**	
3001	17-40775	$5.00(OTS)
NASA-TN-	**(Misc.)**	
D-1901	17-41667	$0.50(OTS)
D-1993	17-41551	$1.25(OTS)
D-2010	17-41552	
NEVIS-	**(Misc.)**	
115	17-41716	Phys. Rev., 132: 1297-1300(1963)
NIRL-R-	**(British)**	
42	17-41244	Dep.(mc); $1.00(BIS); 5s. (HMSO)
43	17-42011	Dep.(mc); $0.70(BIS); 3s. 6d. (HMSO)
46	17-42012	Dep.(mc)
47	17-42013	Dep.(mc)
NLCO-		
887	17-40695	Dep.(mc); $1.60(fs), $0.80(mf) OTS
892	17-41429	Dep.(mc); $2.60(fs), $0.98(mf) OTS
893	17-41193	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NMI-	**(Misc.)**	
1259	17-41352	Dep.(mc); $4.60(fs), $1.58(mf) OTS
1260	17-41386	Dep.(mc); $10.10(fs), $4.10(mf) OTS
2120	17-41353	Dep.(mc); $2.60(fs), $0.95(mf) OTS
NOL-TR-	**(Non-AEC)**	
62-186	17-41663	See CONF-24-18
NP-	**(AEC File No. for Non-AEC Reports)**	
13073	17-41430	Dep.(mc)
13104	17-42051	Dep.(mc)
13105	17-42349	Dep.(mc)

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13106	17-41496	Dep.(mc)
13107	17-41245	Dep.(mc)
13108	17-41497	Dep.(mc)
13110	17-42052	Dep.(mc)
13127	17-41743	Dep.(mc)
13141	17-41498	Dep.(mc)
13147	17-41025	
13156	17-41867	Dep.(mc)
13157	17-41431	
13158	17-41354	
13159	17-41499	
13160	17-41553	
13162	17-42194	
13164	17-40425	Dep.(mc)
13166	17-41554	
13167	17-41387	
13168	17-41355	
13169	17-40483	
13170	17-41175	
13171	17-41176	
13172	17-40484	
13173	17-41177	
13174	17-40485	
13175	17-40442	
13176	17-40486	
13179	17-40487	
13180	17-41178	
13181	17-41179	
13182	17-40443	
13183	17-40444	
13184	17-41356	
13185	17-42014	
13186	17-40976	
13193	17-41026	Dep.(mc)
13199	17-40851	Dep.(mc)
13203	17-42397	Dep.(mc)
13204	17-41246	Dep.(mc)
13209	17-41555	Dep.(mc)
13227	17-41378	
13228	17-41432	
13229	17-40852	Dep.(mc)
13233	17-40488	
NP-tr-	**(AEC File No. for Non-AEC Translations)**	
1066	17-41370	OTS
NRL-	**(Misc.)**	
5938	17-41247	$1.60(OTS)
NUMEC-P-		
62	17-41357	Dep.(mc); $1.10(fs), $0.80(mf) OTS
105	17-41358	Dep.(mc); $3.60(fs), $1.37(mf) OTS
NYO-		
4690	17-41433	Dep.(mc); $5.60(fs), $1.94(mf) OTS
9678	17-41027	Dep.(mc); $7.60(fs), $2.48(mf) OTS
10063	17-40426	Dep.(mc); $10.50(fs), $4.22(mf) OTS
10430	17-41556	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10432	17-40977	Dep.(mc); $3.60(fs), $1.28(mf) OTS
10561	17-41744	Dep.(mc); $7.60(fs), $2.45(mf) OTS
10569	17-40547	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ORNL-		
3355	17-42416	Dep.; $1.25(OTS)
3361	17-42350	Dep.; $2.50(OTS)
3458	17-42398	Dep.; $1.75(OTS)
3482	17-40683	Dep.; $1.75(OTS)
ORNL-TM-		
581	17-40930	Dep.(mc); $5.60(fs), $1.85(mf) OTS
608	17-40684	Dep.(mc); $7.60(fs), $2.48(mf) OTS
613	17-40931	Dep.(mc); $5.60(fs), $1.82(mf) OTS
639	17-41248	Dep.(mc); $1.10(fs), $0.80(mf) OTS
664	17-42417	Dep.(mc); $2.60(fs), $0.86(mf) OTS
665	17-41434	Dep.(mc); $2.60(fs), $0.86(mf) OTS
683	17-41028	Dep.(mc); $6.60(fs), $2.30(mf) OTS
702	17-40957	Dep.(mc); $1.10(fs), $0.80(mf) OTS
709	17-42351	Dep.(mc); $9.60(fs), $3.77(mf) OTS
OTS-	**(Misc.)**	
63-31883	17-41568	For translation see JPRS-21326
PATENTS	**(British)**	**(3s. 6d. each, U. K. Patent Office)**
938,828	17-40481	
938,856	17-41230	
938,861	17-41398	
938,969	17-40826	
938,987	17-42149	
938,994	17-42240	
939,096	17-40898	
939,121	17-40963	
939,183	17-42241	
939,215	17-40827	
939,332	17-40964	
939,475	17-40899	
939,498	17-40900	
939,537	17-40915	
939,650	17-40848	
939,672	17-41374	
939,714	17-42242	
939,721	17-41399	
939,726	17-40984	
939,772	17-41400	
939,800	17-41401	
939,871	17-41402	
939,874	17-41403	
939,973	17-42243	
939,980	17-40948	
939,982	17-42244	
940,056	17-40763	
940,202	17-41404	
PATENTS	**(French)**	
1,225,613	17-42245	
1,229,672	17-42246	
1,230,588	17-42247	
1,234,243	17-42248	
1,234,766	17-42249	
1,234,773	17-42250	
1,235,603	17-42251	
1,252,033	17-42252	
1,253,058	17-41405	
1,260,733	17-42253	
1,261,979	17-40965	
1,262,615	17-40901	
1,263,969	17-42254	
1,264,136	17-41310	
1,264,249	17-41311	
1,264,960	17-42255	
1,266,512	17-42256	
1,266,814	17-42257	
1,269,633	17-42258	
1,270,380	17-41406	
1,276,327	17-42259	
1,277,387	17-42260	
1,277,811	17-42261	
1,278,598	17-41407	
1,278,599	17-41408	
1,279,174	17-41409	
1,279,654	17-40828	
1,279,655	17-40829	
1,282,645	17-41410	
1,283,638	17-42262	

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1,284,927	17-40830	
1,284,928	17-41411	
1,286,412	17-42263	
1,286,538	17-42264	
1,286,969	17-41665	
1,287,618	17-41412	
1,288,272	17-41413	
1,289,264	17-42265	
1,289,365	17-42266	
1,290,450	17-42267	
1,290,952	17-40985	
1,291,124	17-42268	
1,291,294	17-42269	
1,291,351	17-42270	
1,291,702	17-42271	
1,291,909	17-41478	
1,292,073	17-42272	
1,292,317	17-42273	
1,292,866	17-42274	
1,293,073	17-40966	
1,293,880	17-42275	
1,294,194	17-42276	
1,294,391	17-42388	
1,294,664	17-42277	
1,294,665	17-42278	
1,296,252	17-42279	
1,296,865	17-42280	
1,297,266	17-42281	
1,297,686	17-42389	
1,298,020	17-42282	
1,299,348	17-41479	
1,299,368	17-42283	
1,299,652	17-41414	
1,300,486	17-42284	
1,301,079	17-42285	
1,302,484	17-41415	
1,303,489	17-42286	
1,304,797	17-42287	
1,305,509	17-42288	
1,305,511	17-42289	
1,305,651	17-41416	
1,305,694	17-42290	
1,306,977	17-42291	
1,307,134	17-42292	
1,308,258	17-42293	
1,310,819	17-42294	
1,310,838	17-42295	
1,310,876	17-42296	
1,311,360	17-42297	
1,311,425	17-42298	
1,312,093	17-42299	
1,312,824	17-42300	
1,313,033	17-42301	
1,313,196	17-42302	
1,313,368	17-42303	
1,313,894	17-42304	
1,317,497	17-42305	
PATENTS	**(German)**	
1,150,961	17-40831	
1,150,963	17-40916	
1,151,248	17-41417	
1,151,326	17-42306	
1,151,682	17-41312	
1,152,094	17-40832	
1,152,096	17-40949	
1,152,202	17-41313	
1,152,203	17-41173	
1,152,487	17-41314	
PATENTS	**(U. S.)**	
3,105,737	17-41326	
3,105,801	17-40902	
3,105,802	17-40903	
3,105,803	17-42150	
3,105,804	17-42307	
3,105,805	17-42308	
3,105,806	17-42151	
3,105,807	17-42309	
3,105,808	17-42310	
3,105,916	17-42033	
3,106,519	17-42311	
3,106,520	17-42312	
3,106,535	17-41375	
3,106,641	17-41189	
3,107,155	17-40904	
3,107,207	17-40905	
3,107,208	17-40906	
3,107,209	17-42313	
3,107,210	17-42152	
3,107,211	17-42153	
3,107,276	17-41231	
3,107,295	17-41232	
3,107,297	17-41233	
3,107,299	17-41315	
3,107,740	17-42314	
3,108,051	17-42315	
3,108,052	17-42316	
3,108,053	17-42317	
3,108,054	17-42413	
3,108,188	17-41013	
3,108,213	17-41234	
3,108,935	17-42318	
3,108,936	17-42319	
3,108,937	17-42390	
3,108,938	17-42391	
3,109,080	17-41174	
3,109,095	17-41235	
3,109,096	17-40764	
3,109,098	17-41236	
3,109,099	17-40765	
3,109,677	17-40967	
3,109,724	17-40968	
3,109,730	17-41418	
3,109,731	17-41376	
3,109,735	17-41419	
3,109,752	17-41377	
3,110,555	17-40950	
3,110,556	17-40951	
3,110,835	17-41316	
3,110,872	17-41237	
3,111,374	17-40952	
3,111,475	17-42320	
3,111,477	17-42321	
3,111,963	17-40986	
3,112,095	17-40969	
3,112,115	17-40970	
3,112,196	17-42322	
3,112,275	17-40953	
PATENTS	**(U.S.S.R.)**	
21751	17-41317	
PIBMRI–	**(Non-AEC)**	
1025-62	17-42053	$4.60(OTS)
PNE–	**(Misc.)**	
236P	17-40516	Dep.; $1.50(OTS)
PNROO-DEV–		
125	17-41029	$1.10(fs), $0.80(mf) OTS

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PWAC–	**(Misc.)**	
397	17-42154	Dep.; $0.75(OTS)
R–	**(Misc.)**	
2213	17-41491	See EURAEC-662
62SD90	17-41557	$3.00(OTS)
63SD34	17-40776	$8.60(OTS)
63SD62	17-41558	$4.60(OTS)
RAC–	**(Non-AEC)**	
1102	17-41559	$3.60(OTS); Advan. Energy Conversion, 3: 537-49(1963)
RAD-SR–	**(Non-AEC)**	
63-183	17-40777	$3.60(OTS)
RADC-TDR–	**(Misc.)**	
62-284	17-42053	See PIBMRI-1025-62
REIC–	**(Misc.)**	
29	17-41500	Dep.; $2.50(OTS)
REIC-Access–	**(Non-AEC)**	
65	17-41501	$3.60(OTS)
66	17-41502	$3.60(OTS)
RFP–		
329	17-41030	Dep.; $0.50(OTS)
RHD–	**(Non-AEC)**	
Vol.IV,No.5	17-41079	$0.50(GPO)
RM–	**(Misc.)**	
3043-PR	17-41712	$3.60(OTS)
RT-CHI–	**(Italian)**	
(63)-12	17-40696	Dep.(mc)
RTD-TDR–	**(Non-AEC)**	
63-3063	17-41249	$3.60(OTS)
S–	**(Misc.)**	
54	17-41018	See CEX-61.6.1
SA-PR–	**(British)**	
40(Rev.)	17-40517	Dep.(mc)
SAM-TDR–	**(Non-AEC)**	
63-38	17-40489	$1.10(OTS)
SB–	**(Non-AEC)**	
63-21	17-41387	See NP-13167
63-31	17-41554	See NP-13166
63-32	17-41355	See NP-13168
SC-DC–		
3436	17-41359	Dep.(mc); $1.10(fs), $0.80(mf) OTS
3445	17-40978	Dep.(mc); $7.60(fs), $2.48(mf) OTS
SCPRI(RM)–	**(French)**	
VII-1963	17-41031	Dep.(mc)
SLAC–		
18	17-42015	Dep.; $2.50(OTS)
SRB–	**(Non-AEC)**	
61-7	17-41355	Supplemented by NP-13168
62-3	17-41355	Supplemented by NP-13168
SRO–		
94	17-42352	Dep.(mc); $1.10(fs), $0.80(mf) OTS
SSD-TDR–	**(Non-AEC)**	
62-121	17-41560	$4.60(OTS)
STI-DOC–	**(International Atomic Energy Agency)**	
10/19	17-40438	$1.00; Sch 21,-; 6s. stg; F.fr. 4,-; DM 3.20(IAEA)
STI-PUB.–	**(International Atomic Energy Agency)**	
69(Vol.II)	17-41106	Proceedings of the Symposium on Neutron Detection, Dosimetry and Standardization Held at Atomic Energy Research Establishment, Harwell, England, 10–14 December 1962; $13.00; Sch 273,-; 78s.stg; NF 52,-; DM 45,50 (IAEA)
72	17-41080	Proceedings of the Symposium on Criteria for Guidance in the Selection of Sites for the Construction of Reactor and Nuclear Research Centres Held at Bombay, 11–15 March 1963; $10.00; Sch 210,-; 60s.stg; NF 40,-; DM 35,- (IAEA)
STL–	**(Misc.)**	
6212	17-42195	Dep.; $2.50(OTS)
TDR–	**(Non-AEC)**	
69(2230-14)TR-1	17-42048	See DCAS-TDR-62-167
69(2260-21)TN-2	17-41241	See DCAS-TDR-62-172
69(2260-22)TN-1	17-41240	See DCAS-TDR-62-170
169(3230-14)TR-1	17-41560	See SSD-TDR-62-121
TID–		
3910(Suppl.1)	17-40518	Dep.; $2.25(OTS)
6036	17-40778	Dep.(mc); $3.60(fs), $1.19(mf) OTS
7655	17-40697	Dep.; $5.50(OTS)
7664	17-40519	Dep.; $5.00(OTS)
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